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ABSTRACT

The third of four volumes in a series describing the basic documentation practices involved in the initial setting up and subsequent operation of an information-library organization to provide defense-aerospace scientific and technical information services, this manual consists of three sections. "Information Retrieval," by Tom Norton, provides a brief overview of the development of information retrieval (IR) and a model of an IR system. Topics discussed include conventional indexing and postcoordinate indexing systems; problems of vocabulary control, thesaurus construction and presentation; the use of computers to produce indexes (KWIC, KWOC, and SLIC); and the features of computerized "dial up" online information systems. In "Dissemination Practices," Fred Dyer presents an overview of the dissemination of information to the scientific user community, and discusses initial and secondary distribution and the need for automated support of the processes. Appendices provide the results of a survey of national and international technical information centers, which detail charters, databases, practices, and operations. "Microform Systems and Reprography," by Peter Rolls, covers the preparation and reproduction of research and development publications, including technical details of reprographic and microfilm processes, equipment and staff, costs, computer output on microfilm (COM), and practical aspects of quality control for publications in both paper and microfilm formats. (RAA)

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MANUAL OF DOCUMENTATION PRACTICES APPLICABLE TO DEFENCE-AEROSPACE SCIENTIFIC AND TECHNICAL INFORMATION

VOLUME III
containing

Section

7 – INFORMATION RETRIEVAL
8 – DISSEMINATION PRACTICES
9 – MICROFORM SYSTEMS AND REPROGRAPHY

(The complete Publication Layout appears on page iv.)

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GENERAL FOREWORD

The purpose of this Manual is to describe in a series of separately-published Volumes the basic documentation practices which are involved in the initial setting up, and subsequent operation of an Information-Library Organisation to provide defence-aerospace scientific and technical information services.

- The manual is primarily intended for the main defence-aerospace information centres in the smaller nations, and the specialised defence establishments and defence contractors in the larger NATO countries.

- For those information centres which already have a well-developed system, the manual may prove helpful in the work of analyzing and evaluating existing system performance, or in revising an ineffective system. An important subsidiary objective is therefore to encourage the greater use of modern techniques of information processing.

- The manual endeavours to meet the needs of a wide spectrum of readers – the senior man concerned with setting up a new system, as well as junior staff who may be using the manual as a training aid.

- The various Sections aim to focus on the problems and techniques associated with processing unpublished reports and related information, rather than conventional book-journal libraries. Emphasis is on practical solutions and, where appropriate, useful operating suggestions.

The manual has been planned by the AGARD Technical Information Panel and consists of four Volumes comprising twelve Sections in all, each prepared by a well-known expert in the field. The Publication Layout is given on the following page and publication of the final Volume including an Index to all four volumes is scheduled for 1981.

S.C.SCHULER
General Editor
(Former Chairman, AGARD
Technical Information Panel)

MANUAL OF DOCUMENTATION PRACTICES APPLICABLE TO DEFENCE-AEROSPACE SCIENTIFIC AND TECHNICAL INFORMATION

PUBLICATION LAYOUT

Section

VOLUME I

1 ACQUISITION & SOURCES, by P.F.Eckert
Types of material, screening, evaluation, sources in Governments and other countries, information on current research

2 DESCRIPTIVE CATALOGUING, by B.P.Gladd, O.G.Luchaka and J.C.Wade
Functions, standardisation, corporate authors and other compatibility factors, document process sheets, manual and computer translations

3 ABSTRACTING & SUBJECT ANALYSIS, by T.C.Bearman
Abstracting standards, descriptor allocation, thesaurus, computer-aided indexing

VOLUME II

4 DATA RECORDING & STORAGE, by J.H.Petrie
Data preparation rules, handling chemical compounds and scientific symbols, etc., card systems, tape typewriters, introduction to computerised operations

5 MECHANIZATION SYSTEMS & OPERATIONS, by V.J.Rogers
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6 ANNOUNCEMENT SERVICES & PUBLICATIONS, by E.H.Ridler
Selective dissemination of information, bulletin production, newsletters and digests, bibliographies

VOLUME III

7 INFORMATION RETRIEVAL, by T.Norton
Manual systems, searching by computer, inverted files, KWIC/KWOC, on line systems, batch working, packaging of computer output

8 DISSEMINATION PRACTICES, by F.S.Dyer
Register of users, initial distribution, specific requests, recording and recall, guidelines on sensitive aspects, state of art reviews, translations, survey of dissemination practices in various countries.

9 MICROFORM SYSTEMS AND REPROGRAPHY, by P.Rolls
Preparation and reproduction of technical publications, microfiche preparation and duplication, COM/CIM, readers and printers, photocopying, printing processes

VOLUME IV*

10 SECURITY STORAGE & CONTROL
Security gradings, access to sensitive documents, physical security, control of document movements

11 ORGANISATION & MANAGEMENT
Aims and objectives, staffing, promotional activities, identifying users

12 NETWORKS & EXTERNAL SOURCES OF INFORMATION
National and international networks, telecommunication equipment, line techniques, data bases available, costs involved.

13 INDEX TO VOLS I–IV

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* To be issued later. The contents listed here are those presently proposed: they may be amended, however, as their preparation progresses.

Section 7

INFORMATION RETRIEVAL

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United Kingdom

ABSTRACT

After a brief historical overview of information retrieval (IR), a model of an IR system is presented and described. The characteristics of conventional indexing systems are reviewed and shortcomings noted. The principles of postcoordinate indexing systems and examples of feature card and edge-punched card systems with suggested applications are described. Problems of vocabulary control are discussed and suggestions on thesaurus construction and presentation are given. The use of computers to produce various types of indexes (KWIC, KWOC and SLIC) is briefly described. The features of computerised "dial up" on-line information systems are discussed: equipment, telecommunications, file organisation, search preparation and strategy, staff training, advantages and limitations of such systems and future developments. An appendix outlines the principal features of specialised information centres.

CONTENTS

	Page
LIST OF FIGURES	3
1. INTRODUCTION	5
1.1 Scope and Aim of Section	5
1.2 Definition of Information Retrieval	5
1.3 Summary History of IR	5
1.3.1 The Term "Information Retrieval"	6
1.4 Model of an IR System	6
1.4.1 The Input Stage	6
1.4.2 The Output Stage	6
1.4.3 The Index	6
1.4.3.1 Types of index	6
2. PRECOORDINATE INDEXING SYSTEMS	8
2.1 Conventional Classification Schemes	8
2.1.1 The Universal Decimal Classification (UDC)	8
3. POSTCOORDINATE INDEXING SYSTEMS	8
3.1 Punched Feature Cards	8
3.2 Plain Feature Cards	12
3.3 Edge-Punched Cards	13
3.4 Applications	13
4. FILE ORGANISATION	15
4.1 Serial (Uninverted) and Inverted Files	15
5. VOCABULARY CONTROL	16
5.1 Introduction	16
5.2 The Thesaurus	17
5.2.1 Features of a Thesaurus	17
5.2.2 Building a Thesaurus	17
5.3 Links and Roles	19
6. COMPUTER-PRODUCED INDEXES	19
6.1 KWIC Indexes	19
6.2 KWOC Indexes	20
6.3 Program Packages	20
6.4 SLIC Indexes	23
7. COMPUTERISED IR SYSTEMS	23
7.1 Introduction	23
7.2 On-Line Information Retrieval	24
7.2.1 Equipment; Communications	24
7.2.2 Data Base Structure	27
7.2.3 Search Preparation	28
7.2.4 The On-Line Search	29
7.2.5 Training for On-Line IR	29
7.2.6 Advantages and Limitations of On-Line IR	35
7.2.7 Future Developments	36
8. OBSERVATIONS	36
REFERENCES	38
APPENDIX A – A Note on Specialised Information Centres	41

LIST OF FIGURES

		Page
Figure 1	Model of an Information Retrieval System	7
Figure 2	A punched feature card installation	9
Figure 3	A 1000 position punched feature card	10
Figure 4	IR using punched feature cards	11
Figure 5	A punched feature card reader with computer input facility	12
Figure 6	IR using plain feature cards	12
Figure 7	An edge-punched card	14
Figure 8	Direct coding of an edge-punched card	14
Figure 9	Equipment for an edge-punched card system	15
Figure 10	An item/term matrix	16
Figure 11	Sample of KWIC index	21
Figure 12	Page from KWOC index to reports published by the RAE	22
Figure 13	UK access point to ESA/IRS	25
Figure 14	ESANET	26
Figure 15	Tally T1612 RO printer and printer/terminal	27
Figure 16	Model of data base file structure	28
Figure 17	On-line search form	30
Figure 18(a)	On-line inquiry form (front)	31
Figure 18(b)	On-line inquiry form (reverse)	32
Figure 19	BASIC program for DIALTECH (ESA/IRS) accounting	33
Figure 20	Sample search carried out on DIALTECH (ESA/IRS)	34
Figure 21	EURONET	37

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1. INTRODUCTION

1.1 Scope and Aim of Section

The literature on Information Retrieval (IR) is vast and draws on contributions not only from librarianship and computer science but also from logic, linguistics, psychology, engineering and mathematics. It would be impossible within the confines of this Section to deal with more than a small proportion of the topics represented in this literature and such an attempt would inevitably be little more than a superficial check list. Besides, much writing about IR is concerned with experimental and theoretical aspects of the subject and cannot easily be translated into operating principles of practical use in a library unit. This Section of the Manual therefore has a strictly limited scope which can be summarised as follows:

- The principles on which IR systems (manual and mechanised) are based with reference to precoordinate and postcoordinate indexing systems; feature cards, edge-punched cards.
- File organisation (serial and inverted files); vocabulary control; the thesaurus.
- Computer-produced indexes.
- Computerised IR systems: "dial up" data bases; searching; training; future developments.

Microfilm IR systems are covered in Section 9 and are therefore excluded from this part of the Manual.

It may be asked why attention is not focussed exclusively on computer-based methods since the terms "information retrieval" and "computers" are frequently used in such a way as to suggest that they are synonymous. There are two reasons for devoting considerable attention to manual methods:

- There is still a need for simple indexing systems and there is no point in using elaborate methods for small, easily managed collections. Even large library units using computerised methods could still adopt manual or semi-mechanised systems for special collections.
- The principles on which computerised systems are based are those used by manual postcoordinate indexing systems and the computer can be regarded as a machine for carrying out postcoordinate searches.

The aim of this Section is to provide advice so that a rational choice can be made as to the best system for a particular application. It should be understood that the idea of the "best system" means nothing except in relation to a particular set of economic and organisational constraints. The "best system" in one set of circumstances will rarely be so in another. Examples of constraints are: the number of staff available; the number of competent support staff to design and program applications; the number of documents to be indexed each year; the space and equipment which can be provided; funds available for running the unit; speed with which the index must operate.

1.2 Definition of Information Retrieval

Information Retrieval is: "the recovery of specific information from a collection. It includes all the procedures used to identify, search for, find and remove the specific information sought, but excludes the creation and use of that information. The term has now come to be used generically to include the retrieval of references, documents, facts and data as well as information"[1]. This is a comprehensive definition, but in fact most IR systems do not deliver information (which is intangible) or documents or facts and data (though "data banks" are becoming more common) but some form of document substitute, such as a bibliographic reference with or without an abstract. In other words, they are location determining devices.

1.3 Summary History of IR

IR has a history which can be traced back to the earliest libraries. Metcalfe, in his *Information Retrieval, British and American, 1876-1976* (Ref.2) includes two chapters which set the scene by describing library developments from the founding of the library at Alexandria in the 4th century BC to the publication of Melvil Dewey's Decimal Classification Scheme and Charles Ammi Cutter's *Rules for a Dictionary Catalog* in 1876. However, for the present purpose, the history of IR can be usefully summarised in terms of the development of equipment or "hardware" as follows:

- Before 1940 – precoordinate indexes, mostly card catalogues and printed book indexes.
- 1940-1949 – first applications of manual postcoordinate indexing systems, including edge-punched cards and punched feature cards (optical coincidence or peek-a-boo systems).
- 1950-1959 – first widespread use of punched card data processing equipment; early computer systems.
- 1960-1969 – widespread application of digital computers to IR in off-line, batch-processing systems; experiments with on-line systems.
- 1970 to date – growth and widespread use of on-line systems, both "in-house" and external "dial-up" systems; availability of complete systems or "packages" for IR. Development of on-line computerised information networks both national and international[3].

1.3.1 The Term "Information Retrieval"

Calvin Mooers claims credit for coining the term "information retrieval" in 1949. He recounts[4] that he was looking for a term to express the idea of selective rediscovery of information from a large store and after rejecting "cataloguing", "classification" and "indexing" on the grounds that they were too imprecise, he decided that "retrieve" was the most suitable, especially since it had not previously been used in philosophical or library writing. Mooers then tried out the term "information retrieval" in public and one of his papers found its way to the library of the Royal Aircraft Establishment (RAE) in the UK where pioneering research in testing IR systems was being carried out. The RAE researchers began using the term in their reports in 1954[5,6,7] and these reports were circulated back to the United States. According to Mooers it was at this point that the term gained currency and became fashionable.

1.4 Model of an IR System

Figure 1 is a model of an IR system[8]. Since it is a model, it is a selective representation of the features of a real system and is therefore simplified but it will serve to illustrate the components of any IR system, manual or mechanised.

1.4.1 The Input Stage

The input stage consists of the following activities:

- Librarians, information staff select documents which are to be included in the system. The criteria for selection will depend on a number of factors including the mission of the organisation in which the library unit is located.
- Documents are analysed to determine their subject content ("what are these documents about?") and catalogued; subject analysis is dealt with comprehensively in Section 3, Volume I of this Manual.
- This analysis is then translated into index terms which act as shorthand symbols or labels for the subject content of the documents. In many IR systems the index terms are controlled, that is, they are drawn from an approved set of terms that must be used to represent the subject content of documents. Such a set might be organised as a list of subject headings, a thesaurus (see para. 5.2) or a classification scheme. If the index terms are uncontrolled, then they are drawn from words and phrases occurring in the documents themselves (or, more probably, words occurring in the title and abstract).
- The documents are then put into a store and the index records are arranged so that they can be interrogated to satisfy subject and other requests. The index records could be a card file or a machine readable file (usually called a data base).

1.4.2 The Output Stage

The output process is a mirror image of the input process:

- A potential user formulates a query to which the answer is a set of documents satisfying the information need expressed by his query.
- He analyses his request (or a librarian helps him to do so).
- This analysis is translated into index terms drawn from the controlled vocabulary (if one is used).
- The resulting "search profile" is compared with the document profiles in the subject index and documents which meet or partially meet the specification are identified, retrieved from the store and delivered to the user. In some systems the user can check the validity of identified documents from abstracts before the documents are retrieved from store.

1.4.3 The Index

In principle IR is simple: the potential user could obtain the set of documents which satisfies his information need by reading all the documents in the store, keeping or borrowing the relevant ones and discarding the rest. Obviously this is not practicable. The user does not have the time or the inclination to read the entire collection apart from the fact that it may be physically impossible. In addition, for security reasons someone who does not have a specific "need to know" cannot be permitted to browse in a classified document collection. It is the function of an index to act as a filter – to let through wanted references to documents and to exclude unwanted ones.

1.4.3.1 Types of index

The model assumes a *subject* index, but there are other types of index which could be useful:

- A personal author index.
- A corporate author index which shows the institution or corporate body responsible for preparing a document. Rules for determining corporate authors are fully dealt with in Appendix A to Section 2, Volume I of this Manual.
- Report, contract, accession and agency issuing numbers.

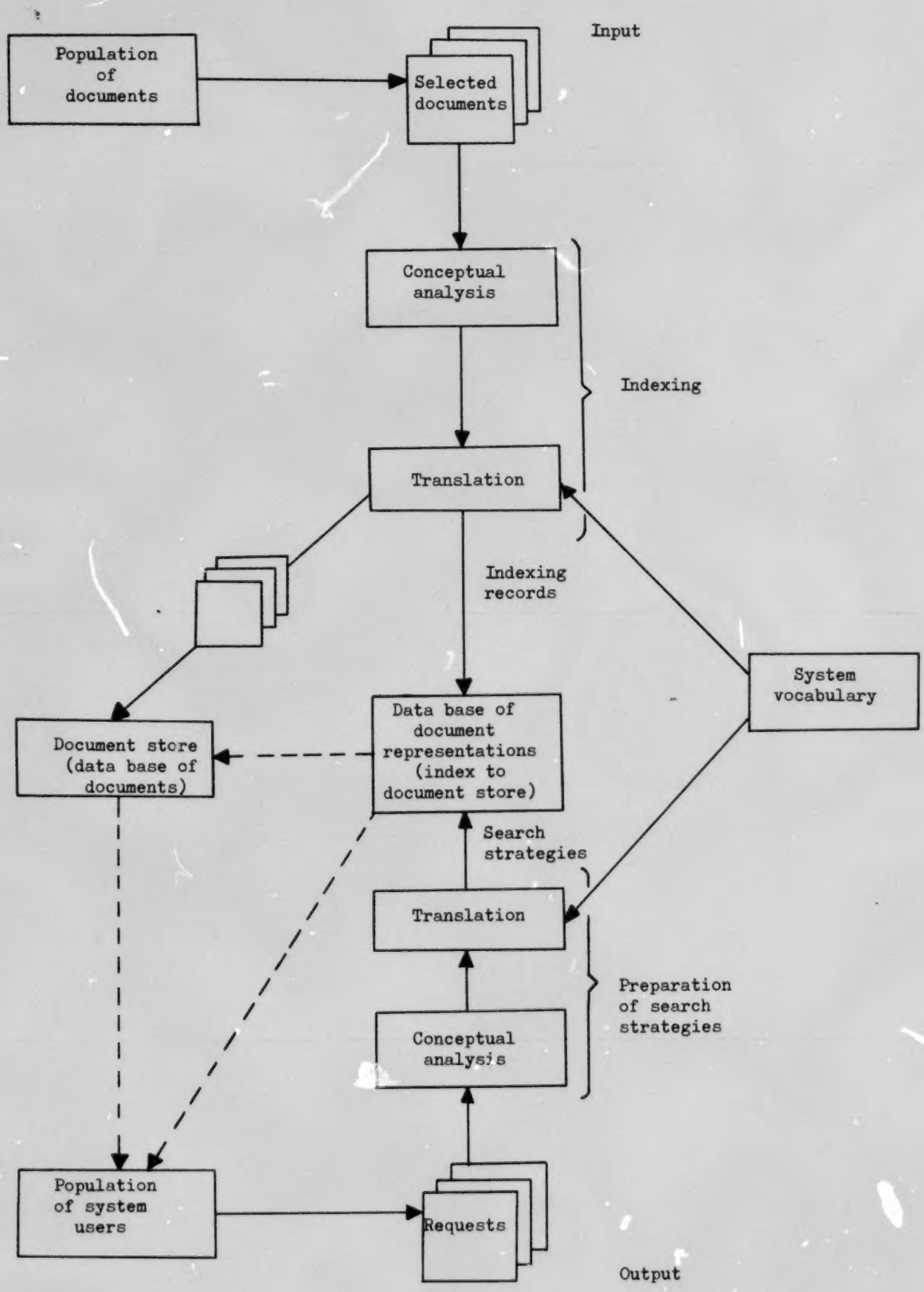

Fig.1 Model of an Information Retrieval System

However, when we think of an IR system we are usually thinking of a system capable of retrieving references in answer to particular *subject requests* and the principal index is therefore a *subject index*.

2. PRECOORDINATE INDEXING SYSTEMS

2.1 Conventional Classification Schemes

The traditional IR system is the library subject catalogue arranged in alphabetic or classified sequence or both and available to the inquirer in card or printed book form. The alphabetical catalogue has predominated in North American libraries while the classified catalogue has been more common in European libraries. The main characteristic of conventional schemes is that terms which make up the index headings (or symbolic representations such as Universal Decimal Classification numbers) are combined (coordinated) at the time the index headings are prepared – i.e., they are precoordinated. Such indexes are also linear in organisation and although an entry can be created to represent a highly complex subject by means of a chain of elements in a subject heading or class number, this entry can generally file only under the first element cited, with the other elements subordinated to it. It is true that a multi-access approach can be provided by various permutations of the index terms and filing them in different places, but the number of precoordinated permutations is limited by practical considerations. For example, a document with 4 index terms could have 15 (i.e. $2^n - 1$) combinations of index terms, but conventional indexes would be prohibitively expensive and bulky if such procedures were adopted. In practice, conventional indexes never have all the possible entry points for all documents. Even so they often still work quite well for the following reasons:

- Indexers tend to assign the most important index terms and useful combinations of terms which are likely to be sought by requesters.
- Behavioural factors such as knowledge of the document collection, intuition, "folk-memory", the requester being satisfied with a small number of documents rather than all the possible documents on a particular subject, enter into the IR process.

2.1.1 The Universal Decimal Classification (UDC)

Since the UDC is the most widely used conventional classification scheme in scientific and technical library units, other conventional schemes will not be considered. The UDC is the lineal descendant of Dewey's Decimal Classification (DDC). Like the DDC it is based on main classes which are divided into sub-classes, proceeding from the generic to the more specific, and the process of sub-division is carried out until the desired level of subordination is reached. Auxiliary devices give the system great flexibility and permit the formation of compound numbers to express complex notions. Nothing further needs to be said about the structure of the UDC since it is so well known and it remains to consider how it works in practice. The UDC works very well in practice and in index language tests has equalled or outperformed its rivals. In spite of theoretical limitations on providing a multi-access approach to subjects and the growth of post-coordinate indexing systems, the UDC is, after 85 years, alive and well and in use in an estimated 100,000 library units (mostly scientific and technical) throughout the world. Under the sponsorship of the Fédération Internationale de Documentation (FID) the UDC has been published in many languages by the various national standardising bodies or other national UDC organisations and it is continuously revised (though somewhat slowly) by a network of national and international committees. The UDC has been applied to machine searching, notably in the American Institute of Physics project AUDACIOUS (Automatic Direct Access to Information with On-line UDC System)[9] and Chiappetti has asserted its superiority when used in conjunction with a thesaurus over multilingual thesauri as a means of retrieving and disseminating the information resources of the European Economic Community[10]. In a multilingual environment the UDC will continue to play an important role in the dissemination of scientific and technical information. Whether an individual library unit should adopt UDC if given the choice to start a new document collection is a different matter. Certainly, UDC is adequate for subject indexing a general scientific and technical book collection, and it automatically organises shelf arrangement. But for report collections, consideration should be given to a postcoordinate indexing system. Libraries which use UDC to subject index reports find the following disadvantages:

- Different indexing approaches: an indexer working in the weapons field will take a different approach from one in the structures field particularly in regard to providing multiple entry points.
- A considerable amount of tedious filing of multiple index cards.
- Since the schedules are revised so slowly, it is increasingly difficult to accommodate new, complex subject areas and home-made extensions have to be made to the scheme.

3. POSTCOORDINATE INDEXING SYSTEMS

3.1 Punched Feature Cards

The inadequacies of precoordinate systems for providing multiple approaches to retrieval were noted at 2.1 above. What is needed is a system in which the index terms which are assigned at the time the document is analysed are all equally accessible and there is no subordination of one term to another. A postcoordinate indexing system is founded on these principles of which punched feature cards (also known as Batten cards, optical coincidence and peek-a-boo

cards) are a practical manifestation. The first systems emerged in the 1940s and W.E.Batten in the UK and G.Cordonnier in France were early pioneers. The system works as follows: each index term (or "descriptor") is represented by a single card and the term is recorded at the top of the card. The remaining surface of the card is divided up so that each square is a grid arrangement of numbered positions and represents a particular document identifying number. So each card contains information about all the documents to which that index term refers. When a document is analysed and indexed, cards representing the classes to which it has been assigned are removed from the file and punched or drilled in the position which represents the identifying number of the document. The index consists of two parts:

- The descriptor file – in alphabetical order.
- The document number file – in running number order with full bibliographic details and possibly an abstract. This file is essential since the descriptor file gives only a document number. The file need not be on cards; an accessions register or a strip index (see Figure 2) could be used, with the strips colour-coded to represent various classes of documents – books, periodicals, reports, classified material etc.

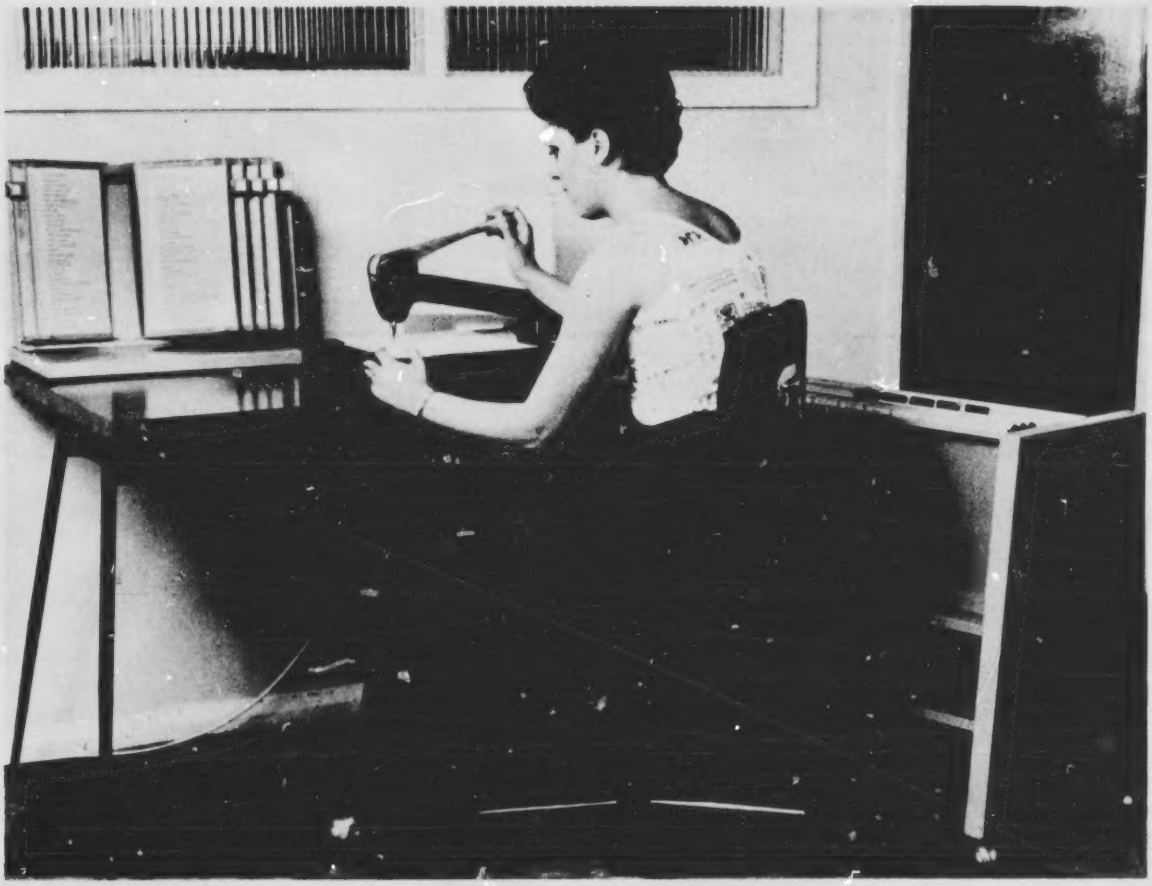

Fig.2 A punched feature card installation

Descriptor cards can be of various number capacities. Figure 3 shows one with 1,000 positions but cards of up to 10,000 positions are available.

When a subject request is put to the system, the appropriate cards which by coordination define the subject, are extracted from the descriptor file and superimposed. Thus, the combination of index terms takes place at the retrieval stage: they are postcoordinated (see Figure 4). The numbers common to all the cards are the identifying numbers of the documents dealing with the subject.

The matching process can be done by placing them over an artificial light source or even by holding them up to the light (hence the term "optical coincidence"). The advantages of a punched feature card system are:

- Faster indexing – no need to decide on a citation order for the various elements of a complex subject and then assign a class number.

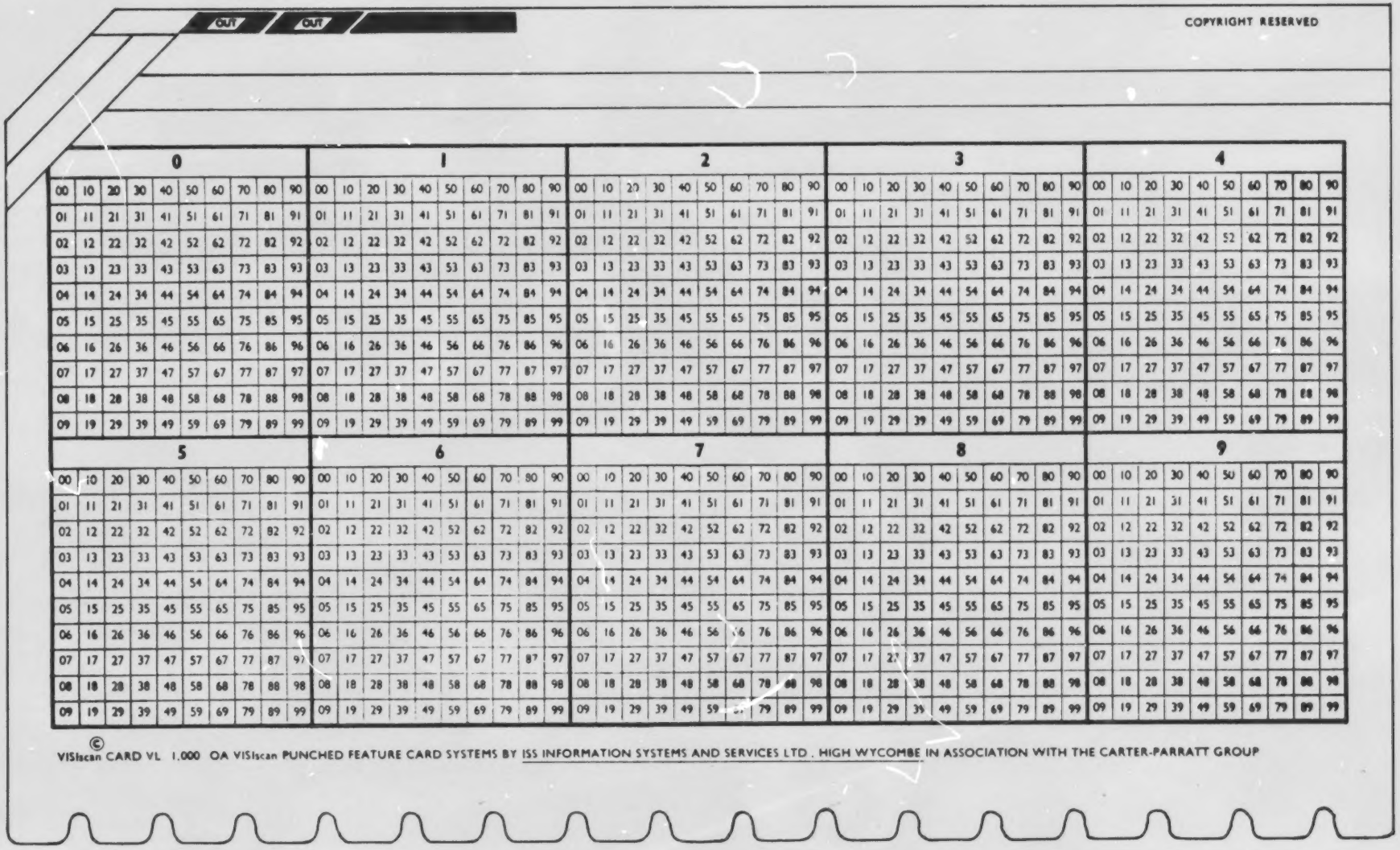

Fig.3 A 1000 position punched feature card

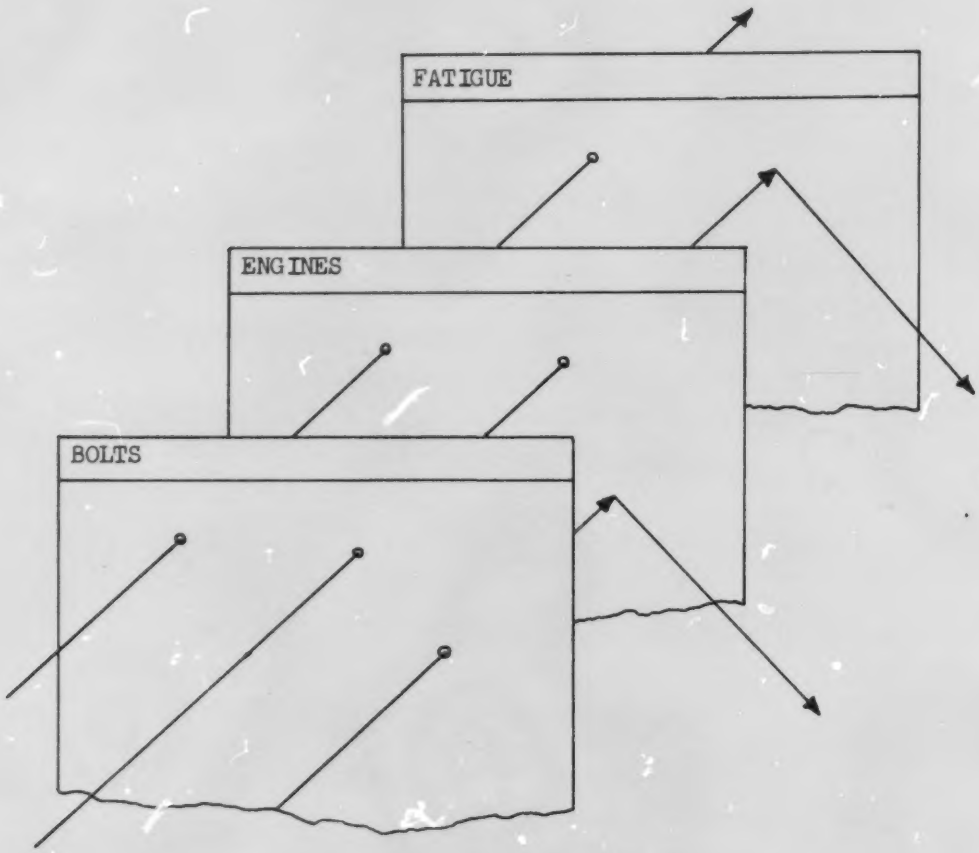

Fig.4 IR using punched feature cards

- No limit to the number of descriptors which may be used.
- The indexing vocabulary can be changed or extended at any time.
- In the example shown in Figure 4 only three cards were needed to express seven possible combinations of the index terms ($2^n - 1$). With a larger number of terms, the economy is even more impressive. For example, a document indexed by ten terms would need 512 entries in a precoordinate system to express all combinations.
- Searching the file is simple, no matter how large it is.
- The system is easily adapted to computer retrieval. Figure 5 shows a system with a punched feature card reader which scans cards individually or in a stack of up to six cards; totals are displayed on a built-in illuminated register. The feature cards can be converted into machine readable form via an interface unit.

Disadvantages are:

- A separate document number file must be kept and searches lead to this and not to details of the documents. This can be more tedious than scanning through cards in a card catalogue or entries in a book catalogue. A strip index file would seem to be the most accessible type of document number file. The documents may also be filed in number sequence (e.g. on microfilm).
- There is a limit (in most systems 10,000) to the number of documents that can be indexed by a given size of card, although continuation via second, third etc. series of cards is quite common.

Johnson[11] has written an excellent account of setting up and operating a punched feature card system and his article has many useful hints and tips on the practicalities involved.

Crosby[12] describes a system he devised called LINOC (LINear Optical Coincidence) which he claims is capable of indexing over 200,000 documents. However, it is not clear from the description whether the system is operational and no illustrations are shown.

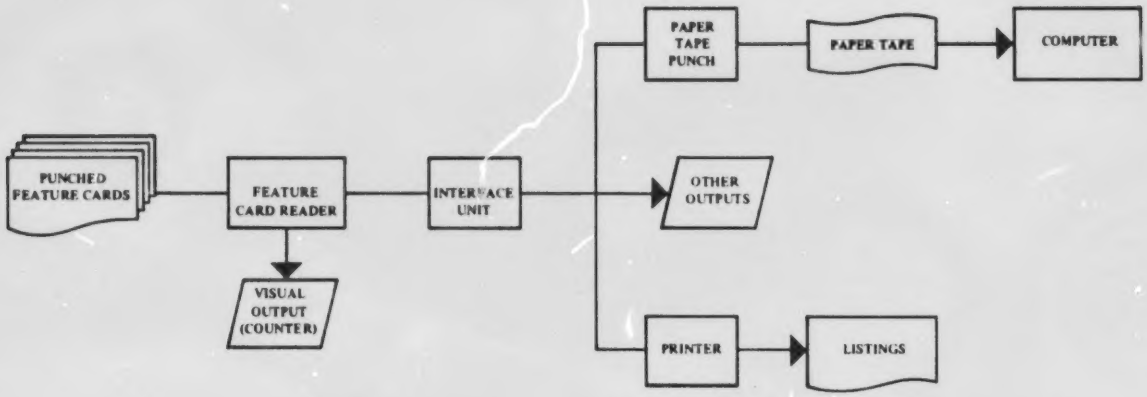

Fig.5 A punched feature card reader with computer input facility

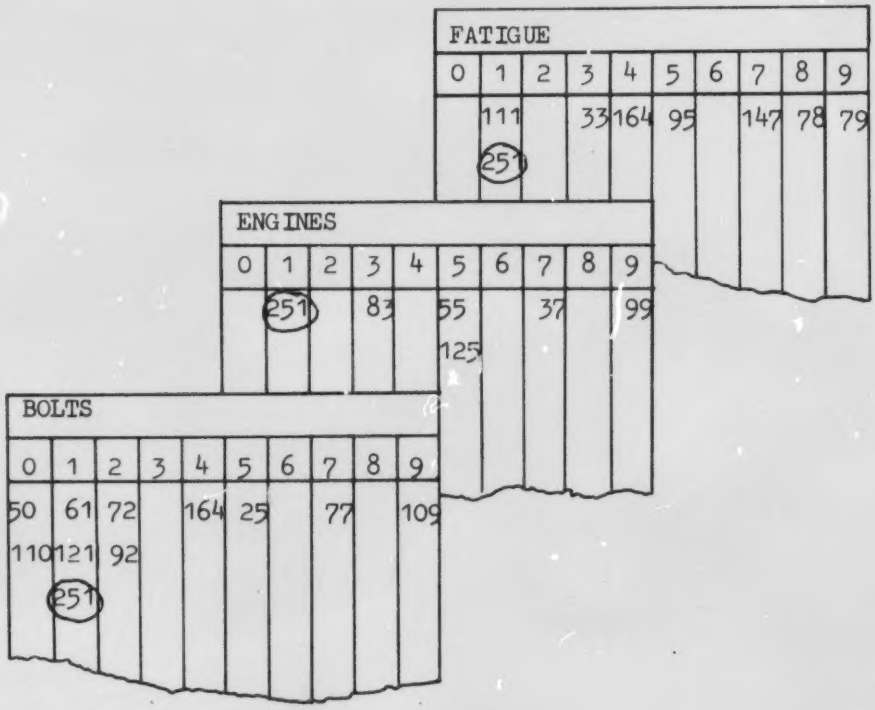

Fig.6 IR using plain feature cards

3.2 Plain Feature Cards

Mortimer Taube appears to have had the most influence on the development of IR systems in the 1950s, largely as a result of his entrepreneurial flair. His system for recording (or "posting") document numbers on term cards and for searching by visually scanning columns of numbers was in some respects a regression when compared with punched feature cards. The Uniterm ("unit term") system that Taube proposed seemed at the time to offer a deceptively simple solution to the problem of subject indexing by using single words ("terms") extracted from the document text and turning the whole process into a clerical operation. To enter a document under a given term, all that is needed is to write the number of the document in the appropriate column. To avoid "bunching" and obtain a more random spread, numbers are entered by terminal digit positioning. To search the file, the cards for the terms to be coordinated are extracted and the numbers on each are scanned to see which appear on all of them. Figure 6 illustrates the process.

A useful but now somewhat old-fashioned version of this system is the computer-printed *dual dictionary*. Each entry is of exactly the same kind as that on a Uniterm card, but several such entries are printed on each page of a book-

type index, with the terms in alphabetical order. Two copies of the index are bound side-by-side, so that one term in one copy can be looked up and a second term in the other copy selected. The displays under the two terms are available side-by-side for comparing the numbers. Common numbers are noted and a third, fourth and subsequent terms are then looked up for further number comparison. Tinker[13] describes a computer-produced dual dictionary on microfilm, the main advantage being that it is easily updated and several copies can be made for distribution to remote locations. The system described by Cherry[14] eliminates the need for a separate document number file. Terms are matched as in a conventional dual dictionary but one half of the dictionary has not only terms and document numbers but a full print out of sufficient bibliographic information to enable the searcher to assess the relevance of the documents. Location details are also given. Van de Gein[15] describes the TOUS (Terminal Operated Uniterm System) in use at the Fokker-VFW Company in Schipol. In 1976 a manually operated uniterm retrieval system (originally introduced in 1972) was automated using a terminal linked to a DEC-10 minicomputer. A current awareness service is also operated. System capacity is 10,000 documents.

3.3 Edge-Punched Cards

Calvin Mooers who has already been mentioned as the originator of the term "information retrieval" was also the originator of the Zator system in 1947 which was implemented by means of edge-punched cards. Edge-punched cards are index cards of various sizes with one or more rows of holes around the edges. A popular size of card is 6 in by 4 in with 72 holes (see Figure 7). In use, the cards are punched by removing the piece of cardboard between the hole and the edge of the card. The holes are given meanings or, to put it another way, each index term is characterised as a single hole or a combination of holes on the card. To sort the cards which have been punched at a particular hole, a needle is passed through the pack at that hole and the pack is shaken; cards which have been punched will fall out, leaving the rest still on the needle. The cards do not have to be kept in any order and after use they can be put back anywhere in the rest of the pack.

Bibliographic information is entered on the body of the card. There is plenty of room for author, title and an abstract. The index terms have to be translated into notches round the card in order to retrieve it and this process is known as *coding*.

The simplest code to punch and to sort is one in which one meaning is assigned to each hole and this is known as direct coding (see Figure 8). It has the advantages of speed and precision; we can go directly to the item we want. However, if there are only 72 holes, this is not a large number and indirect coding has to be used to extend the capacity. There are various indirect coding techniques which need not be described here. There are clear descriptions of these techniques in Jahoda[16], Foskett[17] and Bourne[18].

Advantages of an edge-punched card system are:

- One file gives all the information needed in searching.
- Each card has full bibliographical details.
- Only simple equipment is needed (see Figure 9).

Disadvantages are:

- One card is required for each document, so that large numbers of cards will require significant storage.
- Limit to number of index terms that can be coded.
- A separate record is needed to show codings for names and other index terms.
- Searching a large file is very slow.
- Cards deteriorate with constant use.

3.4 Applications

Some suggested applications for the three systems described in this Chapter:

- Index for general document collection of up to 10,000 items (punched feature cards).
- Index of conference proceedings or translations (punched feature cards or edge-punched cards).
- Index of organisation's own publications (punched feature cards).
- Indexes for specialised collections in an organisation such as a historical collection, a "name" index of missiles, aircraft, projects etc. (punched feature cards or edge-punched cards).
- Index of subject interests of research workers, scientists for distributing documents for current awareness services (edge-punched cards or plain feature cards).
- Recording and analysing literature searches (edge-punched cards)[19].

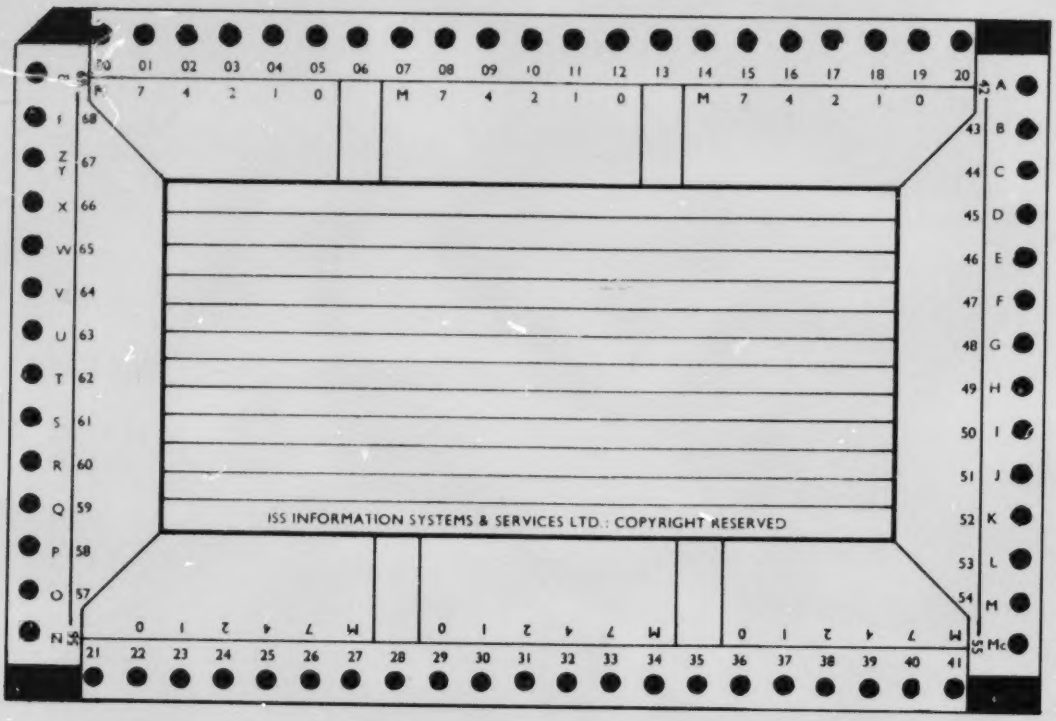

Fig.7 An edge-punched card

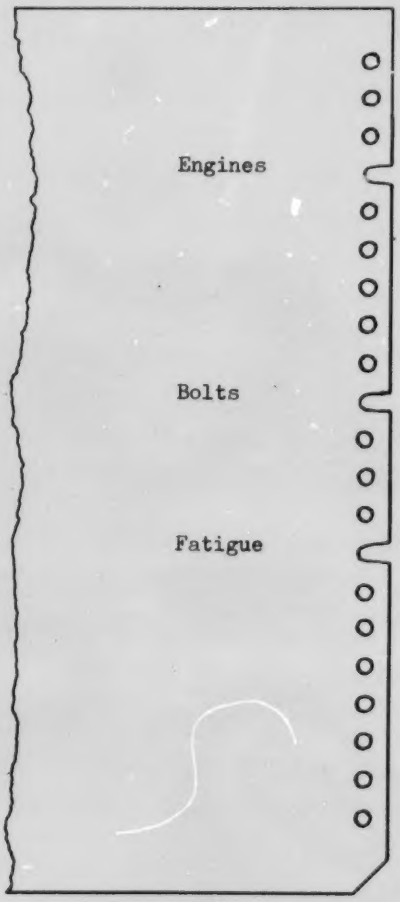

Fig.8 Direct coding of an edge-punched card

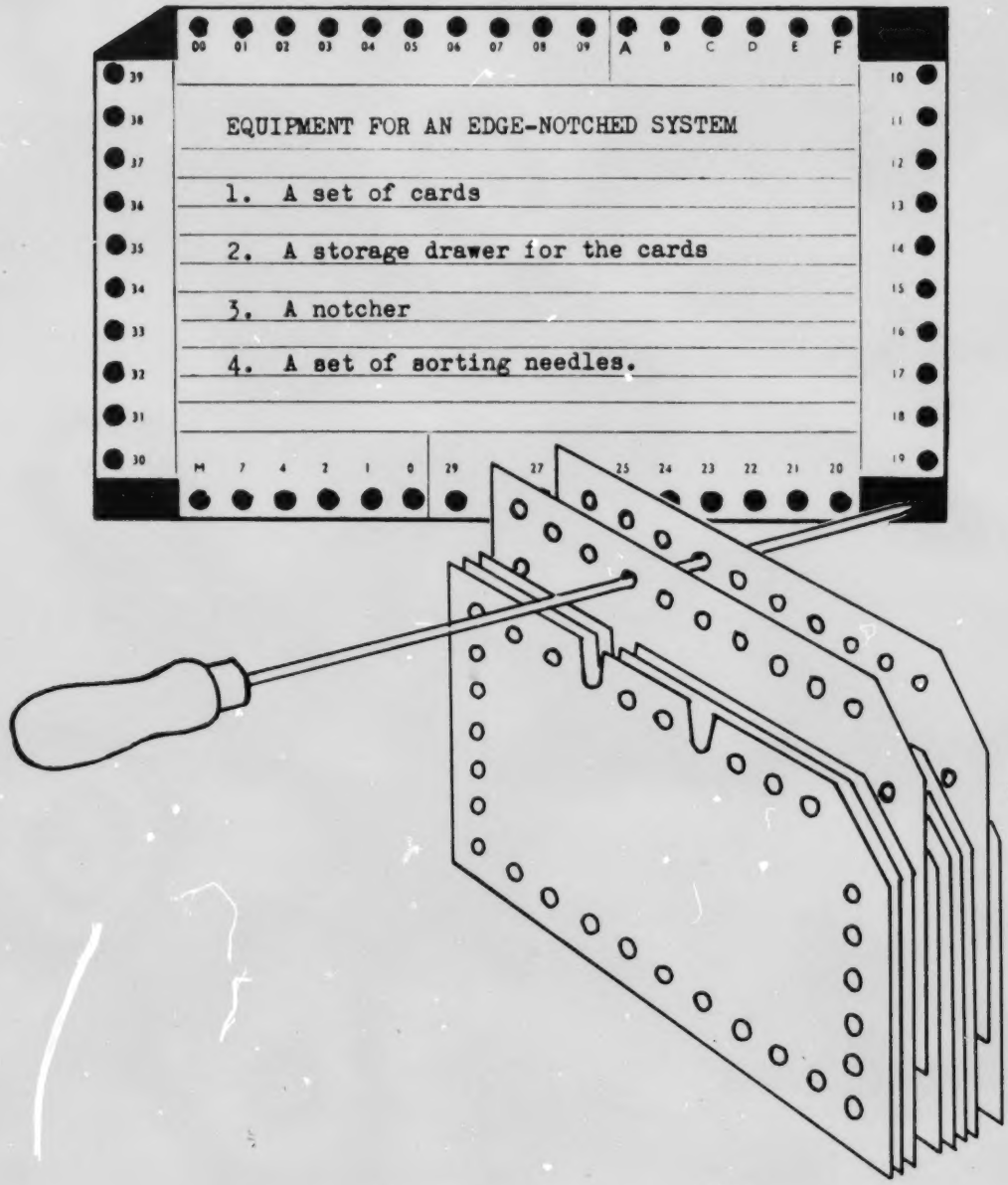

Fig.9 Equipment for an edge-punched card system

4. FILE ORGANISATION

4.1 Serial (Uninverted) and Inverted Files

Edge-punched cards which were described above are an example of an "item" entry system. An item entry system is one where there is a separate record for each item or document and this record identifies the document by means of the usual bibliographic citation which could include an abstract. The conventional library card catalogue is also an item entry system. The alternative to the item entry system is the "term" entry system where the basic records are the terms used in the system, and listed under each term are the identifying numbers of the documents to which that term has been assigned. Punched and plain feature card systems are examples of term entry systems. The relationship between item and term entry systems can be illustrated by means of an item/term matrix (Fig.10(a), (b)). In Figure 10(a): a, b, c and d represent a vocabulary of index terms and 1, 2, 3 and 4 are the identifying numbers of the documents in the document store. When a document is selected for inclusion in the store, it is subject analysed and index terms are assigned (this is the input stage as shown in Figure 1). The presence of index terms is shown by an X in the appropriate cell of the matrix in Figure 10(a). So document 1 has been assigned the index terms b and d, document 2 the index terms a, c, d and so on. Each vertical slice of the matrix represents the characteristics or attributes of a given item and can be considered an "item" vehicle. This conventional way of arranging a file is known as a *serial* (uninverted) file.

If the matrix is turned round and viewed from a different perspective, as in Figure 10(b), we can say that term a has been assigned to documents 2 and 3, term b to documents 1, 3 and 4 and so on. A file arranged in this way, since it is the opposite of the conventional way, is known as an *inverted* file.

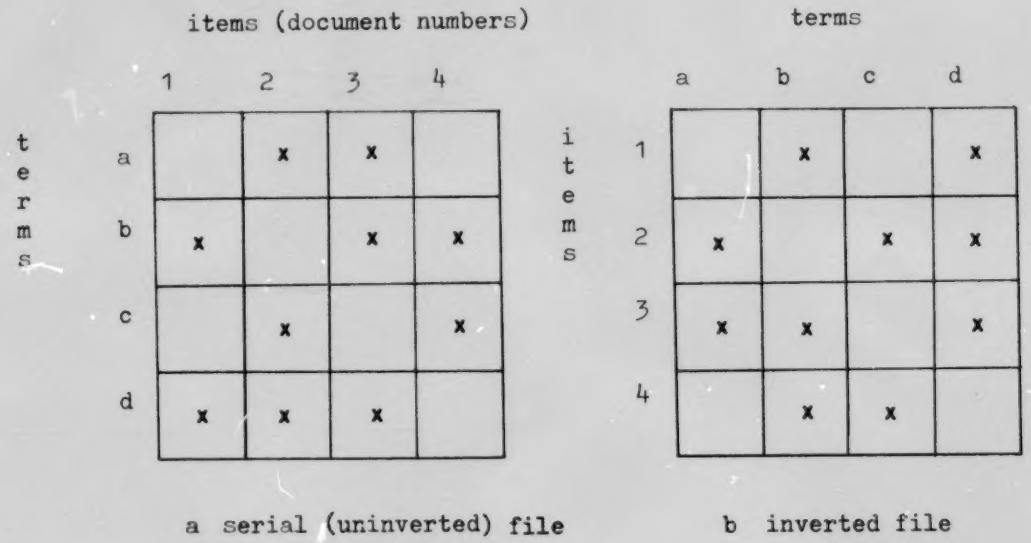

Fig.10 An item/term matrix

The information in the index file can therefore be approached from two different angles:

- Which terms qualify an item?
- Which items are qualified by a given term?

Most index files are organised by term entry (inverted file) or item entry (serial file) (although it should be noted that other arrangements are also used in "data base management systems"). The method of searching the two sorts of file differs:

- Item entry systems must be searched in their entirety; every item has to be examined to see if it meets the requirements of the "search profile". In other words the file is searched serially or sequentially. Since the whole file has to be searched there is no need to keep the file in any logical order (although it can be a positive advantage to do so, particularly in larger systems) and new items can be added on at the end (as was noted with an edge-punched card file).
- Term entry systems do not need to be searched in their entirety; only the items for those terms which meet the requirements of the "search profile" need be selected and the process of number comparison carried out. The file of term entries must be kept in some logical order (usually alphabetical).

To sum up: any type of index no matter how small or large can be viewed as a kind of item/term matrix. In a large system, such as an on-line data base, the matrix will be very large with perhaps 2 million document numbers on one axis and 15,000 terms on the other. See 7.2.2 below for further details of an on-line data base structure.

5. VOCABULARY CONTROL

5.1 Introduction

In a retrieval system in which the indexers use natural language terms to index documents there will be problems of consistency in the way that documents on the same subject are indexed. A particular subject may be represented in different ways in different documents or by different indexers. For example, *aberrations* (in optics) could be represented by the following:

astigmatism	curvature of field
barrel distortion	pincushion distortion
coma	Seidel theory.

The problem for the system user is to think of all the synonyms so that all the relevant literature on a particular subject may be found. An important function of a controlled vocabulary is therefore to specify which of several synonyms is to

be used by indexers and systems users and so avoid the scattering of the same subject matter under different index terms in the system. A controlled vocabulary can take a number of forms. For example, it could be a list of subject headings or some kind of classification scheme. Modern IR systems often use a form of controlled vocabulary which is called a thesaurus.

5.2 The Thesaurus

What is a thesaurus? Who needs it and why? A thesaurus is: "a controlled list of descriptors used to indicate the concepts in a given field, showing relations between conceptually related terms and an alphabetically arranged index if the thesaurus is arranged systematically. A thesaurus usually contains scope notes and information on the system used"[20]. Or, more shortly: a controlled indexing and retrieval vocabulary. The subject content of documents is symbolised by index terms which serve as access points to a document collection. The meanings of words vary according to the indexer or the system user and since individuals associate concepts with different symbols, it would seem useful to have at least one constant in such a semantic kaleidoscope. The word content of a document is a variable while a controlled vocabulary is a constant which both the indexer and the system user may use to provide entry points to the document.

5.2.1 Features of a Thesaurus

A thesaurus provides control over synonyms, it distinguishes homonyms and homographs (words with the same spelling but with different meanings), brings related terms together, and allows for the display of hierarchical relationships. For example, the INSPEC Thesaurus[21] has the entry:

abrasive wear
USE abrasion.

The two terms are considered sufficiently close to be synonymous and are therefore controlled by selecting one and referring from the other by means of the "use" instruction. An indexer is obliged to use "abrasion" and so avoid the scattering of similar subject matter.

bond (chemical)
bond (adhesive).

The above homographs are distinguished by qualifiers in brackets after them.

a.c. motors	
NT	capacitor motors
	commutator motors
	induction motors
	synchronous motors
BT	a.c machines
	electric motors.

In the above example, reference is made from the generic term (a.c. motors) to the more specific ones (NT = narrower terms: capacitor motors etc.) and vice versa (BT = broader terms: a.c. machines etc.). The purpose of making references of this kind is to enable more generic or more specific searches to be carried out. So broader terms can be chosen if the search does not produce any relevant material and a more specific term can be chosen if too much material is retrieved.

absorption	
RT	damping
	fading
	reflection
	sorption
	transmission.

In the above, the related terms (RT) cover the variety of relationships which are not those of a synonym or broader or narrower term. To sum up, the thesaurus can perform essential functions in both the storage and retrieval of documents. By providing a specified vocabulary, a document is described only in terms of the vocabulary of the system. Entrance to the system is only through the vocabulary displayed in the thesaurus. The relationships displayed in a well-constructed thesaurus guide the system user to the desired documents.

5.2.2 Building a Thesaurus

Building a thesaurus can be a formidable task and is time-consuming. Fortunately, for those organisations with suitable manpower and time available, there is an excellent little guide which can be unreservedly recommended: Aitchison and Gilchrist's *Thesaurus Construction: a practical manual*[22] with the emphasis very much on the practical side. There are also a limited number of organisations who specialise in this type of work and who will produce a thesaurus tailored to users' needs in conjunction with users and library staff. Before starting to construct a thesaurus, there are a number of matters to be investigated in the IR system in which the thesaurus will be used.

For example:

- Who are the users of the system and will they operate the system themselves or leave this to a librarian? If the system is user-operated then the language must be simple and without complex devices.
- What type of questions or "search profiles" will be put to the system? Will they be broad or precise? If broad, a detailed vocabulary is not necessary but for specific questions the index terms need to be narrowly defined.
- What sort of indexing system will be used? Is it a pre or postcoordinate indexing system? If the former, the precoordinated terms may be presented as subject headings in a conventional catalogue or in computerised printed indexes. If the latter, it may be a manual plain or punched feature card system or it may be computerised or used manually but computer-produced as are dual dictionaries.

There are various other questions which must be asked at the outset, but they all come down to a thorough investigation of what can be achieved with existing resources and how the system is expected to operate.

After the preliminary investigations have been made, an important question is whether a new thesaurus should be built or could an existing one be adapted. In the defence-aerospace subject field there are certain thesauri which could be of use to the would-be constructor, for example, the EJC (TEST)[23], NASA[24] and INSPEC thesauri. In addition, the various national centres which process defence-aerospace documents are likely to have compiled thesauri for their own IR systems and these could usefully be consulted. Other libraries in defence-aerospace organisations may also have produced thesauri and the wise librarian will use his contacts to gain access to these and possibly save himself some time and trouble. It is unlikely that a thesaurus can be taken over and used without any modification. It is often possible to use one of the larger thesauri as a framework and to develop certain subject areas within it more fully in accordance with the specific needs of the library unit or to extract appropriate sections which are particularly well-developed and which cover subject areas in which the library unit has only a marginal interest.

The process of constructing a thesaurus is described clearly in *Thesaurus Construction: a practical manual*[22] already referred to. In addition, there are guidelines provided by the various national standardising agencies, such as the American National Standards Institute (*Guidelines for Thesaurus Structure, Construction and Use*[25], and the British Standards Institution (*Guidelines for the Establishment and Development of Monolingual Thesauri*[26]). Some aspects of the process which need careful thought are:

- *Definition of the subject field.* A distinction should be made between the central area, which has to be treated in depth and peripheral subjects for which part of an existing thesaurus may be used.
- *Vocabulary size.* The advantage of a small vocabulary is that it is much easier to control and terms can be remembered easily by the indexer and (perhaps more importantly) by the system user. However, a too-small vocabulary can prove virtually useless as a data base grows. Vocabulary size is affected to some extent by the decision to use compound terms or simple terms which can be combined when searching to form the compound term. In a subject field where lengthy compound descriptions are the norm and are used uniquely to represent subject concepts, it would be wise to adopt them.
- *Use of classification principles.* Any consideration of hierarchical relationships – that of genus to species, for example – involves classification whether it is explicitly recognised or not. By deliberately using classification principles, the development of a thesaurus can be carried out more speedily and efficiently. The technique of *facet analysis* is a powerful one and can be used to break down the subject field in order to expose underlying structures. Facet analysis is: "the grouping of terms used in a single field into conceptual categories, each of which has been differentiated on the basis of a different characteristic"[27]. The technique was originally developed by S.R.Ranganathan in the 1930s and is the basis on which his Colon Classification Scheme is built. Although Colon Classification has seldom been applied in practice, its theoretical basis, and facet analysis in particular, have been very influential.
- *Presentation of the thesaurus.* There are a number of possibilities. The most common layout is a display in tabular form with items arranged alphabetically and, under each item, schedules of related terms with the nature of the relationship being indicated. The TEST thesaurus is the best known example (see Vol.II, Section 5, p.63 of this Manual for a sample page). A thesaurus may also be presented with the index terms in alphabetical order within broad subject groups. This is the way the NASA thesaurus is arranged with the terms grouped under subject division according to the COSATI classification scheme. The English Electric Company (UK) THESAUROFACET is the outstanding example of a thesaurus which was developed using the principles of facet analysis and where the role of the thesaurus and classification system are complementary. The thesaurus is an index of the classification and also controls word forms and synonyms and shows relationships which cannot easily be displayed in the schedules. The classification scheme gives an overview of the structure of the subject fields and shows hierarchical and other relationships. More exotic thesauri presentations are diagrammatic displays such as the "arrowgraphs" of the International Road Research Documentation thesaurus and the generic tree displays of the Secrétariat des Missions d'Urbanisme et d'Habitat thesaurus. Examples of these and other kinds of thesaurus presentation are illustrated in Aitchison and Gilchrist[22]. The individual thesaurus constructor is probably best advised to keep to a presentation in the TEST style unless there are particular reasons for doing otherwise.

When the thesaurus has been constructed it will need regular care and maintenance if it is to remain useful and effective. Some terms will turn out to be hardly ever used while others are used so frequently that they are practically useless for retrieval purposes. These terms will need to be broken down into more detailed terms. There must also be plenty of room for expansion.

5.3 Links and Roles

The thesaurus does not eliminate all the language problems which may occur in an IR system. Syntactic ambiguities are caused by the fact that when an indexer assigns index terms to a document, he does not usually indicate the relationships among them. When the system is searched, irrelevant or redundant items will be retrieved.

Links are mechanical devices to avoid false combinations of index terms from the set assigned to an item. Consider an item on the "lead coating of copper pipes" where the links would be:

Lead	*Coating*	*Copper*	*Pipes*
100A	100A	100B	100B

By adding a letter code to the document number, "lead" is linked with "coating" and "copper" with "pipes" and the possible false coordination of "lead" and "pipes" is eliminated. Unfortunately, so also is the useful coordination of "coatings for pipes" and to put this right, the following is needed:

Lead	*Coating*	*Copper*	*Pipes*
100A	100AC	100B	100BC

If the system retrieves terms with at least one suffix in common, then the following combinations are retrieved:

Lead and coating
Copper and pipes
Coating and pipes.

But even now, the useful coordination of "coating" and "copper" is eliminated. So a system of links which eliminates redundancy (or "noise") can also eliminate useful information. Links are however very useful when they are used to separate a multi-topic document into its separate topics, allowing each to be as if it was a separate document.

While links are concerned with the association of index terms at the time a search is carried out, *roles* or *role indicators* are concerned with the further definition of a term in a particular context. They indicate that a term is functioning as, for example, an "end product" or "raw material". Consider the two terms on the following subjects: *the extraction of aluminium from bauxite* and *the welding of aluminium cans.* In the first, aluminium is the end product; in the second it is the raw material from which another end product is made. In a conventional classification scheme the matter would be resolved by placing the first in the metallurgy part of the scheme and the second in container manufacture. In a postcoordinate indexing system roles, if used, have to be made explicit. So two feature cards for aluminium would be necessary:

Aluminium 1 (1 = raw material)
Aluminium 2 (2 = end product).

Discussion of roles and links have featured and continue to feature in the literature of IR. The question must be asked if, in view of the fact that they are expensive and time consuming to implement and moreover introduce fresh ambiguities, they are worth while at all. The answer is "probably not". As Lancaster points out[28], the old classic used to be the need to distinguish between a blind Venetian and a venetian blind. But is anyone likely to be looking for information on blind Venetians? And if they are, would the data base they search also be likely to have references on venetian blinds? And even if it did, would it not be easy to separate out from the retrieved references those on blind Venetians and venetian blinds? In short, it is probably better to tolerate some irrelevancy in output than to spend a great deal of time and effort at the input stage in devising means to eliminate ambiguities which are theoretically possible, but which seldom cause difficulty in an actual operating system.

6. COMPUTER-PRODUCED INDEXES

6.1 KWIC Indexes

Mention has been made of the use of a computer to produce a dual dictionary (3.2 above). The computer can also be used to produce other kinds of printed indexes of which the most widely used form is the KWIC index.

KWIC is a highly appropriate acronym for "Key Word In Context" and the technique was developed by H.P.Luhn of IBM[29]. The index is produced by feeding to the computer the titles of documents to be indexed and the program makes one index entry for each word in the title. The program moves the titles laterally so that the significant word for

a particular entry always appears in the middle of the column. The title will be truncated or "wrapped around" according to the length of print line allowed. These features are illustrated in Figure 11 which shows part of an entry from Chemical Abstracts Review,Vol.85. The "+" indicates the start and the "=" the end of a title. It can be seen that the length of print line permits some titles to be cited in full, while others have had to be shortened. The full bibliographic citation for each title can be found by cross referring from the identifying number in the right-hand column. As a control device, a list of words for which no indexing entry should be made is stored in the computer. This "stop list" of non-significant terms usually includes conjunctions and the indefinite and definite articles. A KWIC index is often called quick and dirty: quick in that it is easy to prepare and cheap to run; dirty in that there will be a number of trivial index entries and, since the vocabulary is uncontrolled, the user has to think of alternative terms that express the subject he is searching for.

Matthews has described the use of additional control features to improve the effectiveness of the KWIC indexes in use at ICI (UK) Ltd[30]. These control methods are:

- *Stringing.* The KWIC program creates an index entry for each "word" not on the stop list. As far as the program is concerned a "word" is a string of alphabetic or numeric characters between two blanks. By inserting hyphens, for example, the program will not recognise certain words for index entry. In another context, the same words might be significant and not inserting hyphens will allow them to be selected for index entry. This method of manually tagging entries overcomes the inflexibility of a stop list.
- *20 character rule.* This is an extension of stringing. The program only creates index entries if "words" are less than 21 characters. Words which are useful in context but have no value can be extended to more than 20 characters by stringing.
- *The double period.* The 20 character rule can cause useful entries to be lost. The program will not index a word ending in 2 periods (full stops). Matthews also describes variations on the basic KWIC format which have been implemented in his organisation. It is evident that KWIC indexing lends itself to a variety of applications and there is great scope for modifications and tailoring to meet particular needs.

KWIC has also been applied to repackaging the output from computer searches. The user selects the items to be indexed, through a regular on-line search. The search can cover any number of data bases and the On-Line KWIC program merges them into a unified KWIC Index that is used as an index to items printed off-line in separate bibliographies. The user can make several copies of the output to provide desk-top reference aids to the personnel who need them until the next On-Line KWIC Index is run[31,32].

6.2 KWOC Indexes

Because the filing of the index words in KWIC is not in the usual place and seems unfamiliar, KWOC (Key Word Out of Context) was developed as a variation. Each index term is extracted from its context and printed separately in the left-hand margin followed by a complete title rather than a shortened version. Figure 12 is a page from a KWOC index to reports published by the RAE. KWOC indexing has been applied to some large, important national collections with a view to making them widely known:

- The US National Technical Information Service (NTIS) has issued on 1400 microfiche, indexes to over 750,000 of its publications from 1964 to December 1978 with separate cumulations for 1979 and 1980. Apart from accession/report number and personal author indexes, there is a KWOC index. An interesting feature is that plural words have been truncated so that the singular and plural forms of a word appear as one group under the singular form. Thus titles containing the words "atmosphere" and "atmospheres" will appear in one sequence under the word "atmosphere".
- The UK British Library Lending Division (BLLD) has holdings of 140,000 serial titles which cover all subject fields and languages and 50,000 of these are current. KIST (Keyword Index to Serial Titles) is a KWOC index on 65 microfiche to this collection. Subscribers receive an updated replacement set of microfiche every 3 months.

6.3 Program Packages

There are a number of program packages for generating and producing KWIC and KWOC indexes[34,35]. Two such packages are:

- ASSASSIN (Agricultural System for the Storage and Subsequent Selection of Information). This package was designed and used at ICI (UK) Agricultural Division but it is not limited to processing agricultural information. The system accepts input in the form of abstracts or documents and provides a wide range of indexes from automatic indexes based on free text to a controlled approach. The package, which is written for International Business Machines (IBM) Computers, is used by many divisions within ICI as well as external organisations[36].
- COIN (COBOL INdexing and maintenance package) is a suite of programs written in International Computers Limited (ICL) 1900 COBOL designed to produce printed indexes including KWIC and KWOC. The package is used by the UK Building Research Establishment to produce serials lists[33] and the British Broadcasting Corporation (BBC) to produce indexes of radio and television broadcasts[37].

```
RPOSE USE=          +NEW   AEROSOL VALVES FOR SPECIAL-PU 85 048115
ND/OR NITROUS OXIDE.    +  AEROSOL WITH CARBON DIOXIDE A 85 037074
APOR DEPOSITION FROM AN    AEROSOL=          +CHEMICAL V 85 080231
F DRUGS ADMINISTERED BY    AEROSOL=        +METABOLISM O 85 000104
ELOPMENT OF ATMOSPHERIC    AEROSOL=   +FORMATION AND DEV 85 098553
 OF BIOLOGIC EFFECTS OF    AEROSOLS AND GASES.  ACID MIS 85 117451
RISKS FROM THE DRUGS IN    AEROSOLS IN GENERAL AND TOXIC 85 117422
     +THE GENERATION OF    AEROSOLS OF FINE PARTICLES=   85 194538
ROPELLANTS FOR COSMETIC    AEROSOLS.  A REVIEW=       +P 85 130344
RY OF       +ATMOSPHERIC   AEROSOLS:  A LITERATURE SUMMA 85 025658
        +FRAGRANCES FOR    AEROSOLS=                     85 010298
             +PESTICIDE    AEROSOLS=                     85 041972
        +PHARMACEUTICAL    AEROSOLS=                     85 130410
ECTRICAL MEASUREMENT OF    AEROSOLS=                +EL 85 099545
D TOXICOLOGY OF INHALED    AEROSOLS=    +PHARMACOLOGY AN 85 014748
NUM IN AERONAUTICAL AND    AEROSPACE APPLICATION:  ADVAN 85 128704
LUIDS AND LUBRICANTS IN    AEROSPACE APPLICATIONS=     F 85 096642
ROCESS DEVELOPMENTS FOR    AEROSPACE=         ALLOY AND P 85 128649
TRUCTURE OF PSEUDOMONAS    AERUGINOSA AS RELATED TO RFSI 85 000732
ANTIGENS OF PSEUDOMONAS    AERUGINOSA=   +VIRULENCE AND  85 074600
SISTANCE IN PSEUDOMONAS    AERUGINOSA=  BASIS OF DRUG RE 85 002207
 ELECTRON SPECTROSCOPY (   AES) AND SECONDARY ION MASS S 85 071556
 SPECTROSCOPY (ESCA AND    AES)=  SAMPLES USING ELECTRON 85 197154
A REVIEW OF RECENT LEED-   AES-XPS RESULTS=  SURFACES:   85 025652
+ANOTHER FOOD CHEMICAL,    AF-2, ALPHA-2-FURYL-5-NITRO-2 85 031635
ETS.  PART I.  STATE OF    AFFAIRS=       SPOT WELDED SHE 85 097384
ESSANTS, TRYPTOPHAN AND    AFFECTIVE DISORDER=  ANTIDEPR 85 103593
ATE IN THE TREATMENT OF    AFFECTIVE DISORDERS?=  CARBON 85 086932
       +BIOCHEMISTRY OF    AFFECTIVE DISORDERS=          85 190161
EUROPHARMACOLOGY OF THE    AFFECTIVE DISORDERS=       +N 85 000054
YCHOPHARMACOLOGY OF THE    AFFECTIVE DISORDERS=       PS 85 116433
NOSIS AND MEDICATION OF    AFFECTIVE DISORDERS= THE DIAG 85 103591
TS IN THE ASSESSMENT OF    AFFECTIVE STATES IN MAN=      85 116434
EVANT REGULATION OF THE    AFFINITY AND CONCENTRATION OF 85 137613
HARACTERIZATION OF THE  +  AFFINITY CHROMATOGRAPHY AND C 85 073542
ZYME    +GENERAL LIGAND    AFFINITY CHROMATOGRAPHY IN EN 85 073965
CLEIC ACIDS AND         +  AFFINITY CHROMATOGRAPHY OF NU 85 058907
LYLYSINE-SEPHAROSE 4B= +   AFFINITY CHROMATOGRAPHY ON PO 85 119486
PURIFICATION.  LIGANDS,    AFFINITY CHROMATOGRAPHY, ENZY 85 073965
  +DESIGN PARAMETERS IN    AFFINITY CHROMATOGRAPHY=      85 074372
                        +  AFFINITY CHROMATOGRAPHY=      85 099054
                        +  AFFINITY CHROMATOGRAPHY=      85 099055
ATRIXES FOR BIOSPECIFIC    AFFINITY CHROMATOGRAPHY=    M 85 155862
LICATION OF BIOSPECIFIC    AFFINITY CHROMATOGRAPHY=  APP 85 106123
THE CARRIER MATERIAL IN    AFFINITY CHROMATOGRAPHY=  AS  85 043101
FFINITY AND HYDROPHOBIC    AFFINITY CHROMATOGRAPHY=+BIOA 85 015937
   +THE SPECIFICITY AND    AFFINITY OF ANTIBODIES TO STE 85 091918
LS FOR REFRACTORY  +THE    AFFINITY OF THE PLATINUM META 85 164910
H AND          +NEGATIVE   AFFINITY PHOTOCATHODE RESEARC 85 152311
 WITH NEGATIVE ELECTRON    AFFINITY SURFACES=    DEVICES 85 168951
ALLIC REACTIONS=        +  AFFINITY-CONTROLLED ORGANOMET 85 123996
INS WITH ALTERED OXYGEN    AFFINITY=          +HEMOGLOB 85 138680
TIC AMINES, SAFROLE AND    AFLATOXIN B1=      WITH AROMA 85 104711
        +THE ROLE OF       AFLATOXIN IN HUMAN DISEASE=   85 041880
 MYCOTOXINS, ESPECIALLY    AFLATOXIN MUTAGENESIS=     ON 85 057549
        +EFFECT OF         AFLATOXIN ON ANIMALS AND THE  85 014749
ILLUS TOXINS OTHER THAN    AFLATOXIN=          +ASPERG S 041579
                        +  AFLATOXINS AND THE LIVER=     85 014733
```

Fig.11 Sample of KWIC index

FREE-FLIGHT	TR 74029	BOUNDARY-LAYER PRESSURE FLUCTUATIONS AT HIGH REYNOLDS NUMBERS ON A SECOND FREE-FLIGHT TEST VEHICLE (74.05) D.R. ROBERTS	ST
	TR 74054	FREE-FLIGHT MODEL DYNAMIC STABILITY MEASUREMENTS ON A 'NOT-SO-SLENDER' WING/FIN COMBINATION AT ZERO AND SMALL LIFT M = 0.8 TO 2.0 (74.06) G.H. GREENWOOD , G.F. EDWARDS	A
FREQUENCIES	TR 74027	THE PROCESSING OF RESPONSE DATA TO OBTAIN MODAL FREQUENCIES AND DAMPING RATIOS (74.04) K.H. HERON , D.R. GAUKROGER , C.W. SKINGLE	ST
	TR 75005	AN INSTRUMENT FOR THE RAPID REMOVAL OF DC LEVELS WITH MINIMUM AC ATTENUATION OF VERY LOW FREQUENCIES (75.02) G.R. SUTTON , R.H. STANFORD	M
	TR 75046	AN INSTRUMENT FOR MEASURING LOGARITHMIC DECREMENTS AT VERY LOW FREQUENCIES (75.05) G.R. SUTTON , R.H. STANFORD	M
FREQUENCY	TR 74038	THE FREQUENCY RESPONSE OF ANGULAR VIBRATION AND ACCELERATION TRANSDUCERS HAVING GAS ROTORS (74.06) J. KNIGHT	IR
	TR 75122	THE MEASUREMENT OF THE RESONANT FREQUENCY OF SHOCK ACCELEROMETERS (75.12) W.H.E. HAMPTON , J. KNIGHT	IT
FREQUENCY-SWEEP	TR 74129	AN APPLICATION OF FAST FREQUENCY-SWEEP EXCITATION TO THE MEASUREMENT OF SUB-CRITICAL RESPONSE OF A LOW-SPEED WIND TUNNEL MODEL (75.03) C.W. SKINGLE , D.R. GAUKROGER	ST
FRETTING	TR 75132	STUDIES IN FRETTING FATIGUE UNDER VARIABLE AMPLITUDE LOADING CONDITIONS (75.12) P.R. EDWARDS , R.J. RYMAN	ST
FRICTION	TR 74045	THE FRICTION AND WEAR OF NON-GRAPHITIC CARBONS (74.05) J.K. LANCASTER	M
	TR 75129	STABILIZATION OF THE FRICTION AND WEAR OF CARBONS BY ADDITIVES PART 1 GRAPHITIC CARBONS (76.01) J.K. LANCASTER	M
FRIEDEL-CRAFTS	TR 74047	THE EFFECT OF WATER ON CARBON FIBRE COMPOSITES PART 3 CHANGES IN INTERLAMINAR SHEAR STRENGTH OF EPOXY VINYL ESTER FLRAN AND FRIEDEL-CRAFTS COMPOSITES AFTER IMMERSION IN WATER AT ELEVATED TEMPERATURES (74.06) N.C.W. JUDD , C.H. JUDGE	M
	TR 75115	FRIEDEL-CRAFTS RESIN/CARBON FIBRE COMPOSITES 5 CHEMICAL RESISTANCE (75.10) B.M. PARKER	M
FUEL	TR 74065	SPONTANEOUS IGNITION OF AN AIRCRAFT SAFETY FUEL UNDER SIMULATED CRASH CONDITIONS (74.07) R.E. MILLER , S.P. WILFORD	M
	TR 75067	FLIGHT TRIALS WITH FOAM IN A FUEL TANK OF A COMET IVC AIRCRAFT (75.07) J.A. MACDONALD	EP
FLRAN	TR 74047	THE EFFECT OF WATER ON CARBON FIBRE COMPOSITES PART 3 CHANGES IN INTERLAMINAR SHEAR STRENGTH OF EPOXY VINYL ESTER FLRAN AND FRIEDEL-CRAFTS COMPOSITES AFTER IMMERSION IN WATER AT ELEVATED TEMPERATURES (74.06) N.C.W. JUDD , C.H. JUDGE	M
FUSELAGE	TR 74073	INTERFERENCE PROBLEMS ON WING-FUSELAGE COMBINATIONS IN INVISCID INCOMPRESSIBLE FLOW (74.09)	

Fig.12 Page from KWOC index to reports published by the RAE

KWIC and KWOC indexes rely on the titles of documents being informative and this is generally the case with scientific and technical reports. Titles can also be supplemented or "enriched" by adding extra key words which will be processed as index entries.

Suggested applications for KWIC and KWOC indexes:

- announcement, accessions bulletins,
- indexing literature surveys,
- indexing conference proceedings,
- personal files of journal references or reports,
- short-term laboratory data compilations,
- journal (serials) holdings lists[33],
- indexing scientific and technical reports collections.

6.4 SLIC Indexes

It was noted at 2.1 above that the only way to provide multiple-access in a precoordinate indexing system is to make entries for all the possible combinations of the index terms by permutation. Since permutation is an expensive way of providing for finding combinations, it would clearly be useful if it could be eliminated. Since permutation is concerned with arranging terms in different orders the first thing is to fix the order of the terms. When this is done, all combinations are kept in that order. All entries which form the beginnings of longer entries are eliminated. This is the principle of a SLIC (Selective Listing in Combination) index. To illustrate how it works:

Engines, Bolts, Fatigue

A	B
Total number of possible combinations $(2^n - 1)$	*Entries in a SLIC Index* $(2^{(n-1)})$
1. Engines	1. Engines, bolts, fatigue
2. Engines, bolts	2. Engines, fatigue
3. Engines, bolts, fatigue	3. Bolts, fatigue
4. Engines, fatigue	4. Fatigue
5. Bolts	
6. Bolts, fatigue	
7. Fatigue	

Thus in column A, entry number 3 will also cover numbers 1 and 2 which are thus dispensed with and number 6 covers 5 which can also be dropped leaving the reduced number of entries shown in column B. It is not however practicable to use SLIC for a large number of index terms, but five is a reasonable number and produces 16 entries. This is too many to use in a manual system, but practicable with a computer. SLIC was originated by John Sharp who provides a fuller description of the main features[38,39].

7. COMPUTERISED IR SYSTEMS

7.1 Introduction

In the summary history of IR (1.3 above) it was noted that in the 1950-1959 period, punched card data processing came into widespread use. Existing manual postcoordinate systems were convertible to punched card operations with former edge-notched card systems using a card sorter and plain and punched feature card systems using a collating device. These systems were largely superseded in the 1960s by computer systems using magnetic tape as the storage medium for data. A development at the end of this period was the application of computer processing and type setting to the major abstracting and indexing services. A by-product of these processes was a magnetic data tape which could be loaded into a computer system and searched by undertaking a serial record-by-record scan of each tape. The method of searching these tapes was to construct "search profiles", batch them together and run them against the records on the tape. Batch searching is still frequently used, particularly to provide current awareness services; many personal profiles can be matched during a single run and so the average unit cost is fairly low. Current awareness activities and Selective Dissemination of Information (SDI) are described in detail in Volume II, Section 6 of this Manual.

Batch methods for comprehensive retrospective searches are not satisfactory; it becomes time-consuming and uneconomic to do lengthy computer runs except where a number of searches can be run together. Another disadvantage of batch searching is that the searcher cannot modify his strategy during the run. If the references retrieved are unsatisfactory, then the profile has to be amended off-line with resulting delay and possibly irritation for the system user. For retrospective searching, the more rapid access that fast-access devices (such as magnetic discs) in on-line systems offer is needed.

7.2 On-Line Information Retrieval

In the mid 1960s there were a number of projects under way which were to prove important in the future development of on-line access to bibliographic data bases. Two such projects were:

- The System Development Corporation (SDC) of Santa Monica, California was providing an on-line service to a data base of 200,000 references for 13 government and private organisations. This work was sponsored by the Advanced Research Projects Agency (ARPA), of the US Department of Defense. By 1968 SDC had developed a program package for on-line searching known as ORBIT (On-Line Retrieval of Bibliographic Information Time-Shared)[40].
- The Lockheed Missiles and Space Corporation of Palo Alto, California were developing a program package for on-line searching for the National Aeronautics and Space Administration (NASA). The package was called RECON (Remote Console) and was based on their own DIALOG package. The RECON system allows NASA installations, Industrial Applications Centers, contractors and various government agencies to interrogate on-line the NASA data base. The RECON package was made available to the European Space Agency (ESA) in 1969[41].

In the library sense an on-line bibliographic data base generally means a collection of bibliographic records held on-line in a fast-access computer store (usually a disc file). "On-line" means that the searcher is in direct communication with the data base he wants to search and to the computer in which it is stored. The method of accessing and searching an on-line data base can be summarised as follows: the searcher first makes contact with the computer which holds the data bases he wishes to interrogate; he then carries on a dialogue with the data base by means of computer programs designed to make the on-line system available to inquirers. Such a process is also called "interactive" use of the data base. The searcher samples the on-line store and refines or alters his query until he obtains a satisfactory set of references. The final set of references can be printed out immediately at the searcher's terminal or can be ordered as an off-line print to be sent on to him. This process will now be examined in detail and the description is concerned with data bases which are held in computer stores outside the searcher's organisation. "In-house" on-line IR is not specifically considered and although much of what follows is common to external and internal systems, reference should be made to Volume II, Section 5 of this Manual for detailed consideration of the latter.

7.2.1 Equipment; Communications

Figure 13 shows the UK access point to the European Space Agency's Information Retrieval Service (ESA/IRS). This access point is part of the ESA/IRS communications network known as ESANET (Fig.14) which has over 10,000 kilometres of leased telephone lines and stretches from Stockholm in the North to Rabat in the South. The UK end of ESA/IRS is known as DIALTECH and is managed by the Technology Reports Centre (TRC) of the Department of Industry. To communicate with the ESA/IRS host computer which is located at Frascati, near Rome, the searcher needs a terminal. Terminals are of two kinds:

- a *video terminal* which resembles a television screen with a typewriter keyboard.
- a *printer/terminal* which resembles a conventional typewriter.

The searcher uses the terminal keyboard to send messages to the system and the responses are displayed on the video terminal or recorded on the paper output of the printer/terminal. It is desirable that a video terminal should be supplemented with a "slave" printer which can be switched on when necessary to record a search strategy or capture references retrieved. An example of a "slave" printer is the Tally T1612 shown in Figure 15 (background). This type of printer is also known as an RO ("Receive Only" – it has no keyboard and messages cannot be sent) machine. The Tally T1612 shown in Figure 15 (foreground) is an example of a printer/terminal.

The UK searcher makes contact with TRC by dialling a telephone number. The terminal and the host computer communicate by means of information which is in digital form; the telephone system is designed to carry information in analogue form – electrical signals into sound waves. To convert digital signals to sound waves and back again a *modem* (modulator/demodulator) is necessary. A modem is usually rented from the national public telegraph and telephone (PTT) authority and is a fixture. An alternative is a type of modem called an *acoustic coupler* which is portable and can be used with any telephone handset. There are some printer/terminals which have acoustic couplers built in as part of the machine.

At TRC incoming telephone calls are consolidated or "concentrated" by a PDP 11 minicomputer which acts as a Remote Terminal Concentrator (RTC) into a single telecommunications channel and sent at high speed to Frascati. A second PDP 11 minicomputer drives a high-speed line-printer for producing off-line prints of requested references.

The usual operating speed for a terminal is 30 characters per second (cps) which is near to normal reading speed and printer/terminals often have the additional advantage of using quiet non-impact printing methods. This can be an important consideration if it is necessary to locate the terminal in a public area of a library unit. A terminal operating at 120 cps can also be used and can be used for printing out retrieved references on the spot when a 30 cps machine would make it prohibitively expensive. A terminal operating at 240 cps is used by TRC for its TECHSEARCH service to carry out searches on behalf of Department of Industry customers who do not have their own terminals. The Defence Research Information Centre (DRIC) performs a similar service for the UK defence community. Useful advice on terminals and telecommunications can be found in Hall[42], Houghton[43] and Wallace[44].

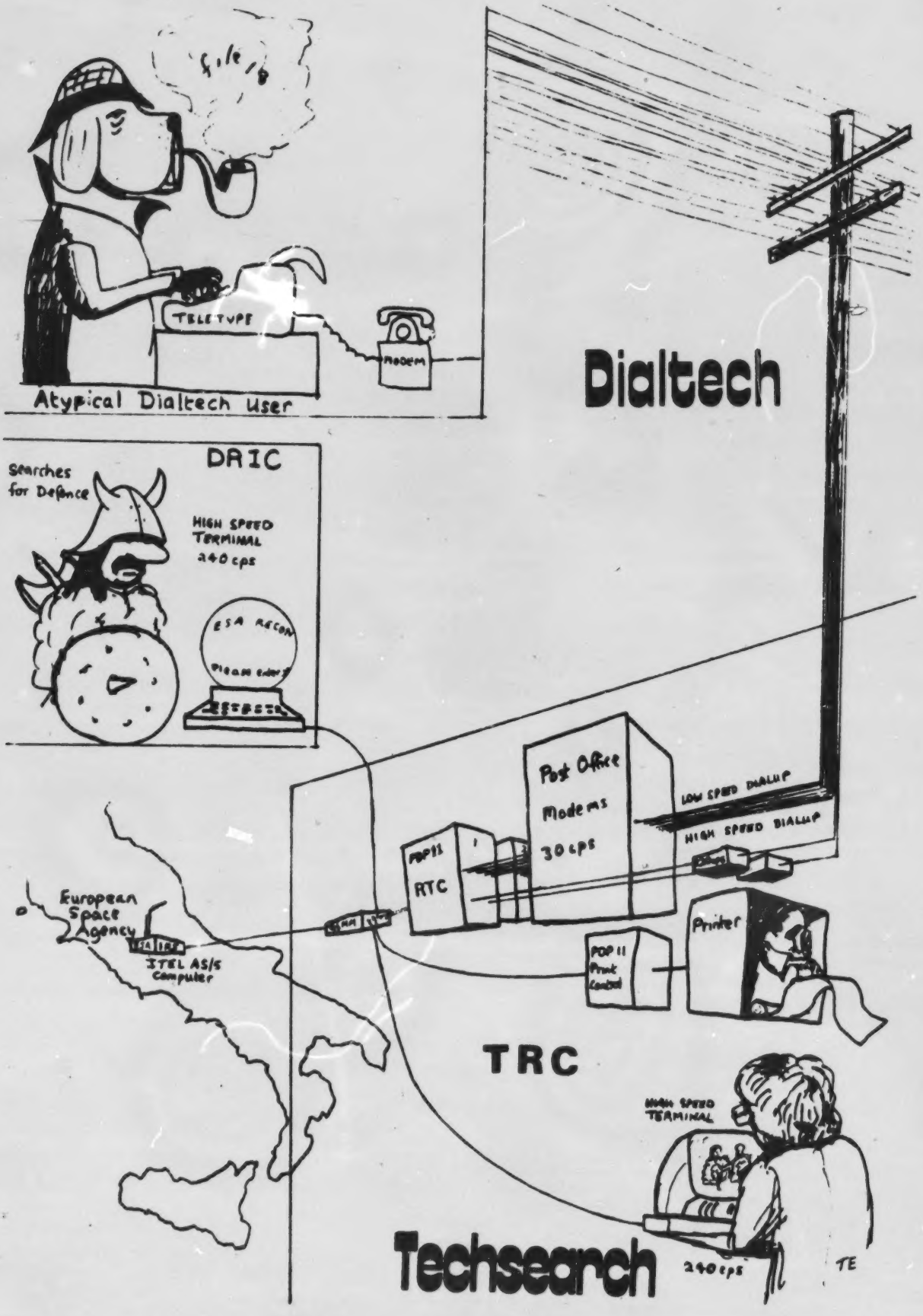

Fig.13 UK access point to ESA/IRS

Fig. 14 ESANET

□ concentrator
○ high speed terminals
△ remote printing
† facsimile

Fig.14 ESANET

Fig.15 Tally T1612 RO printer (background) and printer/terminal (foreground)

7.2.2 Data Base Structure

The principles of serial (uninverted) and inverted file organisation were described above at 4.1 and the on-line data base is structured in accordance with these principles. Figure 16 is a model of a data base file structure. There are 3 separate but closely related files which are held on a magnetic disc or some other fast-access device. The 3 files are:

- the index file,
- the inverted file of postings,
- the serial (uninverted) print file.

The *index file* is an alphabetical list of the searchable terms in the data base. Linked with each term are 2 items of data:

- the address on the disc where the "postings" for this term are held,
- the number of postings associated with this term (i.e. a count of the number of references to which this particular term has been assigned).

The *inverted file* stores, for each term which appears in the index file, a list of all the document numbers to which the term applies.

The *serial (uninverted) print file* is arranged in record number or accession number order and stores various bibliographic data including possibly an abstract and a list of the index terms associated with the document.

It can be seen that the foregoing description corresponds closely to the organisation of files in manual postcoordinate indexing system described in Chapter 3. The index and inverted file are the descriptor file and the print file is the document number file. The matching process of superimposing punched feature cards or comparing numbers corresponds to that of combining sets where the computer systems also carry out comparison tests. The main difference, of course, is that the on-line data base may hold over a million document references instead of merely thousands, and large numbers of search terms can be manipulated in seconds. In Figure 16 the comparison of record numbers in the inverted file shows that only number 36 meets the specification of being by "Schuler" and about "documentation".

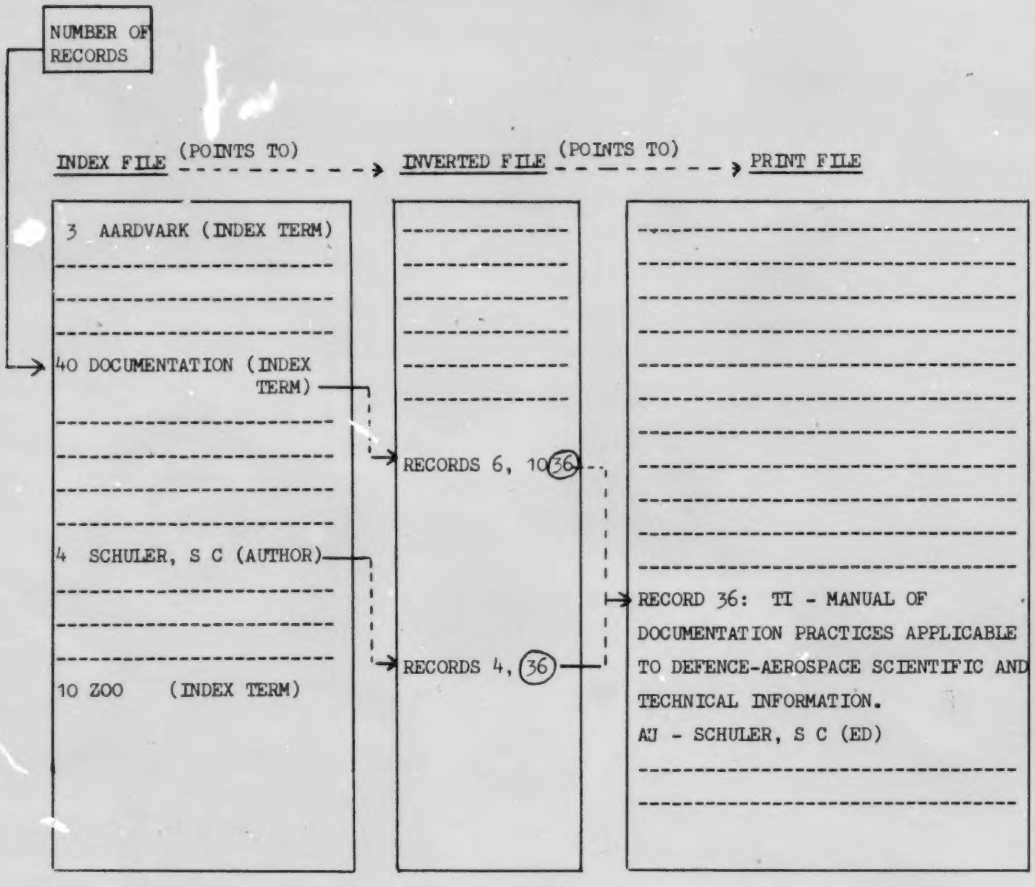
NUMBER OF RECORDS
INDEX FILE (POINTS TO)
INVERTED FILE (POINTS TO)
PRINT FILE
3 AARDVARK (INDEX TERM)
40 DOCUMENTATION (INDEX TERM)
4 SCHULER, S C (AUTHOR)
10 ZOO (INDEX TERM)
RECORDS 6, 10, 36
RECORDS 4, 36
RECORD 36: TI - MANUAL OF DOCUMENTATION PRACTICES APPLICABLE TO DEFENCE-AEROSPACE SCIENTIFIC AND TECHNICAL INFORMATION.
AU - SCHULER, S C (ED)

Fig.16 Model of data base file structure

Other features of an on-line retrieval system are:

- *Display of the indexing vocabulary of the data base.* The system can be commanded to display the terms alphabetically adjacent to any search term along with the postings for each term. Related terms can also be shown and the searcher can incorporate these into his search strategy.
- *Truncation device.* The sample search in Figure 20 shows the use of the truncation symbol, "?". By entering "ink?" all terms beginning with "ink" (e.g. "inks", "inking" etc.) will be automatically selected.
- *Print formats.* There are a number of options available. The searcher can request that records of varying length – bibliographic citation only, citation plus index terms, citation plus abstract – be displayed. In some systems it is possible to use a "sort" command to organise the output in a particular way.
- *Free text searching.* As well as using a controlled vocabulary, some data bases index natural-language terms occurring in the titles and abstracts of documents. A natural-language system is likely to be superior to a controlled vocabulary system for carrying out highly specific searches. It enables the searcher to look for documents in which individual organisations, products, processes and individuals are named. On a general point, human indexing of documents is costly and it is quite likely to be cheaper to put abstracts or partial text (such as summaries or conclusions) into machine-readable form for searching purposes. Martin[45] describes tests carried out by the ESA on NASA Scientific and Technical Aerospace Reports (STAR) tapes for 1973 and 1974 using either controlled vocabulary or a special natural-language index. Results showed the natural-language index to be superior in many ways to the controlled vocabulary.

7.2.3 Search Preparation

In order to make the best use of relatively costly on-line time, a certain amount of search preparation is necessary and the various steps can be summarised as follows:

- Consult the inquirer and define the subject as precisely as possible. Is a broad comprehensive search required or a small number of highly relevant references? What sort of references are required (e.g. "state-of-the-art reviews")?.

- Any restrictions as to date, language?
- Any references known to be relevant? (Useful for finding relevant authors and index terms.)
- Any particular files to be searched or is the choice left to the intermediary?
- Analyse the subject and list the main concepts. Translate them into search terms using a thesaurus if necessary (see Figure 1 – the output process).
- Think of alternative terms. Allow for American spelling (e.g. "fibre/fiber", "organisation/organization" – both forms of the latter term can be taken care of by inserting a "universal character", thus: "organi#ation"). Remember that multilingual data bases such as *PASCALINE*, the machine-readable version of *Bulletin Signalétique*, can be searched in French, German and English and search terms in these languages should be included in the search strategy.

Points like these can be noted on a simple inquiry form illustrated in Figures 18(a), 18(b) and used by the UK Atomic Weapons Research Establishment (AWRE).

For control and accounting purposes, details of searches undertaken can be noted in a register or on a search form such as the one illustrated in Figure 17 and used by the UK AWRE. Where several on-line systems are used and payment is in different currencies, the accounting can get a little complicated. Southampton University Library (UK) use simple computer programs written in the BASIC programming language and run on a PDP 11 minicomputer to control their expenditure. The program for DIALTECH (ESA/IRS) accounting is reproduced at Figure 19.

7.2.4 The On-Line Search

Figure 20 illustrates a simple search carried out on the INSPEC data base on ESA/IRS. After logging into the system and identifying himself by means of a password, the searcher selects the data base he wishes to search by issuing a command, which is a formal instruction to the computer system. The dialogue with the system is carried on by means of such commands. Words and phrases which describe the subject of the search are entered and the system reports the number of references which match the search statement, transfers them to a temporary working store and assigns a reference number to this "collection" or set. Sets can be combined using Boolean operators, chief of which are AND, OR and NOT. Two of these operators are illustrated in the simple search. A more complex search profile together with a detailed explanation of Boolean operators can be found in Volume II, Part 6, pages 110-112 of this Manual. The search illustrates the process of inspecting references retrieved, selecting further index terms and combining further sets until a satisfactory search has been completed. An off-line print is then requested, but the references could quickly have been printed out by the searcher on a 120 cps printer/terminal. Alternatively, if a large number of references had been retrieved and it was necessary to scan them all, the accession numbers only could have been printed on the spot and the abstracts consulted in the appropriate printed volumes if the searcher's library subscribes to them.

Presentation of on-line search results can be a problem and inquirers are unlikely to be impressed by multiple pages of references printed on the usual computer line-printer paper. There are a number of possibilities for improving the appearance of search results:

- It was noted at 7.2.2 above that some on-line systems included a "sort" command for organising the output of retrieved references.
- Retrieved references can be repackaged in KWIC format (6.1 above).
- If abstracts need to be studied, the inquirer can be referred to the typographically more attractive printed indexes.
- Many terminals used for on-line searching have "intelligence" (i.e. they can be programmed) and they can be used to reformat the references retrieved and present them in an attractive way.

7.2.5 Training for On-Line IR

In a contribution to the First International On-Line Information Meeting, held in London in December 1977, Williams[46] concludes that the best way of carrying out on-line searches is to have an intermediary do the job with the requester present to give advice and assistance. Many library units have found this to be so in practice. On-line searching is not a skill which once learned (like swimming) can easily be recalled. Constant practice is needed to remain proficient. There are so many new developments in facilities available on data bases that only personnel who are regularly carrying out searches can keep up to date. There are various possibilities for training:

- New users can benefit by watching a skilled searcher carry out an on-line search.
- Study of sample searches in systems manuals (produced by all on-line service suppliers).
- Hands on practice under the friendly guidance of a colleague.
- Attending courses organised by service suppliers. ESA/IRS National Centres organise regular training courses.
- Joining the various national on-line user groups and attending meetings.
- Keeping up to date by studying newsletters produced by service suppliers and reading such serial publications as *Online*[47] and *Online Review*[48].

AWRE ON-LINE SEARCH

SYSTEM: Lockheed / DIALOG

ENQUIRY No. 444

SEARCHED BY: JWB

DATE: 30/8/79

CUSTOMER: Dr CF BURBAGE

ADDRESS: SDO C16

TELEPHONE No.: x 9016

SUBJECT OF SEARCH:

Tuning of large neodymium glass lasers

LOGON TIME: 3:40:20

LOGOFF TIME: 3:56:05

File No.	File Name	Search Time	Items Retrieved	T or PR and Format
13	INSPEC (78/79)	0.074	5 12	T/6 PR/S
12	INSPEC (69-77)	0.198	6 6 5 15	T/6 PR/S T/6 PR/S

M1916/77

Fig.17 On-line search form

	AWRE INFORMATION ENQUIRY	444

Enquirer: Dr C.F. BURBAGE Telephone No. x 9016

Address: SDO C16

Brief Description of Enquiry:

Tuning of large Neodymium glass lasers

Additional Details:

frequency stability and mode locking

Level of sophistication required:

review articles preferred

Sources already consulted by Enquirer and References known:

—

Urgency: 2 weeks

Foreign Languages: French or German only

Period to be covered: 1970 to date

Books ☐ Review Articles/Bibliographies ☑ Journal Articles ☑

Patents ☐ Reports ☐ Classified Literature ☐

Fig.18(a) On-line inquiry form (front)

Date Received: 30.8.79 Searched by: J.W.B.

External Sources Consulted:

DRIC/RECON ☐ AWRE/DIALTECH ☐

Comments/Results

Terms from INSPEC Thesaurus:

LASERS, LASER TUNING, LASER FREQUENCY STABILITY
REVIEWS

Other terms:

ND GLASS, NEODYMIUM GLASS, MODE LOCK, MODE LOCKING

30.8.79 Online Search: Lockheed DIALOG

INSPEC file 13 1978-9 5 titles typed
12 abstracts printed offline

file 12 1969-77 6 titles typed
6 abstracts printed offline (review articles)

5 titles typed
15 abstracts printed offline

6.9.79 Offline prints sent to Dr Burbage

M925/78

Fig.18(b) On-line inquiry form (reverse)

```
DIALTE.BAS[ 14 , 1 ]        11-Oct-79     16:01
30  REMARK DIALTECH ACCOUNTING PROGRAM APRIL 1979
50  PRINT
60  PRINT "?LAST TOTAL?"
70  PRINT
80  INPUT T9
100  PRINT
105  LET S1, S2, S3 = 0
110  PRINT "?SEARCH NO?"
120  PRINT
130  INPUT S$
190  PRINT
200  PRINT "? FIRST SET EG:-"
220  PRINT
230  PRINT ".....MINUTES IN FILE"
232  PRINT ".....PRINTS"
234  PRINT ".....AU APPROX TOTAL"
240  GOTO 260
250  PRINT "? NEXT SET OR 0 ?"
260  PRINT
270  INPUT N1
280  IF N1 = 0 THEN 340
290 INPUT N3,N2
300  LET S1 = S1 + N1
310  LET S2 = S2 + N2
320  LET S3 = S3 + N3
330  GOTO 250
340 REMARK ALLOW FOR AM OR PM GPO CHARGES
350  PRINT "TYPE IN 'AM' OR 'PM'"
360  PRINT
370  INPUT N$
380  PRINT
390  IF N$ = "AM" THEN 410
400  IF N$ = "PM" THEN 430
410  LET G1 = 0.18
420  GOTO 440
430  LET G1 = 0.12
440 REMARK COMPUTER TOTALS
450  LET T1 = S1 * G1 * 1.15  ! TOTAL GPO CHARGE INC. VAT @ 15%
460  LET T2 = S2 * 0.67205 * 1.15  ! AU TOTAL IN POUNDS STERLING PLUS VA
T @15%
470 LET T3 = S3 * 0.022 * 1.15  ! TOTAL PRINT CHARGE PLUS VAT @ 15%
480  LET T4 = T2 + T3  !TOTAL DIALTECH CHARGES INC. VAT
490  LET T5 = T1 + T2 + T3  !GRAND TOTAL
500 REMARK RUNNING TOTAL
510  LET T9 = T9 + T5
520  PRINT
530  PRINT
540 REMARK PRINTOUT OF RESULTS
550  PRINT "THE TOTAL CHARGES IN POUNDS STERLING FOR SEARCH(ES) "S$" ARE
:-"
560  PRINT
570  PRINT       "  DIALTECH     GPO       TOTAL    RUNNING TOTAL  "
580  PRINT USING "   ###.##     ###.##     ###.##     ###.##   ", T4, T1, T5, T9
600  PRINT
610  PRINT "? RE-RUN:   'Y' OR 'N' ?"
620  PRINT
630  INPUT Y$
640  IF Y$ = "Y" THEN 100
650  IF Y$ =  "N" THEN 670
660 GOTO 610
670  PRINT
675  PRINT "DON'T FORGET TO BYEF!!!!"
680 END
```

Fig.19 BASIC program for DIALTECH (ESA/IRS) accounting

```
Dialtech SEARCH:ANALYSIS OF THE INK JET PRINTING PROCESS
File 08: INSPEC:1971-78,19 <-- Choose database (Inspec): Response to 'Begin 8' command.
          SET ITEMS DESCRIPTION
          --- ----- -----------
? SINK? <-- User enters command next to question mark.
            1   342 INK? <-- Select 'NK? (? gives right-hand truncation)
                           (Response from computer)
? SJET?
            2  5111 JET?
? SDROP?
            3  4635 DROP?
? SPRINT?
            4  5015 PRINT?
? C1*(2+3)*4
            5   153 1*(2+3)*4 <-- Combine sets (* = AND, + = OR)
? SANALYS?
            6 84311 ANALYS?
? SFLOW
            7 37302 FLOW
? SFLUID(W)DYNAMICS
            8  1567 FLUID(W)DYNAMICS
? SVISCOSITY
            9  4807 VISCOSITY
? SRHEOL?
           10  1111 RHEOL?
? C5*(6+7+8+9+10)
           11    12 5*(6+7+8+9+10)
? T11 <-- Type first reference (most recent) in Set 11.
78A025766, 78B018188  INSPEC  Journal Paper
  Drop formation characteristics of electrostatic ink jet using
water colored ink
  Asui, T.; Nakajima, M.; Nishimura, S.
  Imaging Sci. & Engineering Labs., Tokyo Inst. of Technol., Tokyo,
Japan
  Electrophotography (Japan), vol.15, no.2 1170474 elpya, 1976,
38-45. In Japanese , 6 Refs Treatment EXPERIMENTAL
  Classification Codes: A4110D, B8660, B5180D
  Controlled Terms: electrostatics / jets / drops / capillarity /
printing
  Uncontrolled Terms: electrostatic ink jet / ink drop frequency /
ink flow / ink drop diameters / capillary

? SAERODYNAMIC?
           12  2409 AERODYNAMIC?
? C12*5+11
           13    18 12*5+11
? T13/6 <-- Type refs from 13 in Format 6 (Titles only)
78C005977  INSPEC  Journal Paper
  Aerodynamic correction for ink jet printing

78C003793  INSPEC  Journal Paper
  Compensating for aerodynamic drag in an ink jet printer

78A025766, 78B018188  INSPEC  Journal Paper
  Drop formation characteristics of electrostatic ink jet using
water colored ink

77B040157, 77C024749  INSPEC  Journal Paper
  Development and characterisation of ink for an electrostatic ink
jet printer

77B040155, 77C024745  INSPEC  Journal Paper
  Drop charging and deflection in an electrostatic ink jet printer

? PR13/4 <-- Order off-line printout of set 13 in format 4 (includes abstract)


P13/4/1-18

          LOGOFF                    Logoff
```

Fig. 20 Simple search carried out on DIALTECH (ESA/IRS)

Fig.20 Simple search carried out on DIALTECH (ESA/IRS)

- Practising on training data bases. For example, Lockheed's ONTAP (On-line Training And Practice) using a sub-set of the low cost ERIC data base; users can elect to perform searches of varying difficulty and have their performance assessed. ESA/IRS offers a sub-set of the INSPEC data base relating to information science, again at a low access fee.

7.2.6 Advantages and Limitations of On-Line IR

Following are the main advantages of on-line IR:

- Easy and rapid access to a wide range of data bases, many of which may not be available locally. The user can have access to over 40 million references which are up-dated at the rate of 5½ million a year. Occasional access can be made to data bases which could not be justifiably purchased in printed form (not to mention storage limitations). Information is bought when needed instead of being routinely bought as an insurance against possible need.
- The user is an active participant and can adjust his search strategy and recover from errors of poor query formulation. A whole data base can be re-searched if necessary whereas this would be a formidable and boring task with large numbers of printed index volumes.
- Elimination of tedious note-taking, typing and photocopying which is characteristic of manual searching. Output can be sorted in different ways – by author, title or journal and compiled in a form useful for the requester.
- On-line data bases can be searched by many more access points than a printed index. For example, a data base may have 15-20 index terms assigned to each item and all of these can be searched; the corresponding printed version would be limited to four or five index entry points for cost reasons.
- The data base is normally much more up to date than the corresponding printed indexes.
- Closer contact with users. Most searches are done by a librarian/information officer and it is helpful to have the user present to help direct the search by identifying suitable keywords, changing the search strategy where necessary and suggesting the follow-up of fruitful lines of enquiry which often unexpectedly suggest themselves in such a "conversational" method of working. The librarian can also introduce users to other aspects of the library service at the same time.

Limitations:

- System difficulties. Reliability and availability of many systems could be much better. (Printed indexes are always available.)
- Data bases often do not extend as far back as required, for example, *Chemical Abstracts* are available on-line from 1969 whereas the printed volumes have been published since 1907. *Physics Abstracts* which have been published since 1898 are only available on-line from 1969.
- Expense. Highly visible charges are incurred each time an on-line search is carried out whereas printed indexes can be searched an unlimited number of times at no obvious extra cost. The cost of storing printed indexes is an overhead cost, more or less independent of the volume of use.
- Only one searcher can use a terminal at a time (though it should be noted that on-line searches are much shorter than searches through printed indexes).

The question is sometimes raised as to whether printed indexes can be dispensed with altogether, given the availability of machine-readable versions. It has already been noted that data bases are relatively recent and that older issues of indexes need to be consulted. Ideally, a library unit should subscribe to printed indexes which are extensively used and fundamental to the work it is engaged in. It is difficult to imagine that a defence-aerospace organisation could do without the printed volumes of NASA STAR (Scientific and Technical Aerospace Reports) and IAA (International Aerospace Abstracts). European users of on-line systems pay much higher network charges than their North American colleagues and it would not take many on-line searches to exceed the subscription costs to the IAA and STAR printed volumes. Another reason for having printed versions of fundamental abstracts and indexes is that some queries are most effectively answered by scanning entries in a printed index and some are so easily dealt with by such conventional methods that the cost of doing them on-line is unwarranted. For example, a simple check of bibliographical details for which most of the information is already available can be done by checking printed abstracts. On the other hand, complicated coordination of several index terms is very difficult to do manually and is best carried out on-line.

There is a good deal of uncritical writing about on-line IR and it is difficult to find cautionary and detached opinions. Some of the exaggerated claims for on-line are reminiscent of the extravagant claims of the 1940s and early 1950s concerning microforms and how they would make print obsolete. Harry Collier's sober words are worth reflecting on: "Long, long ago there were just books. Then there were books and journals. Then there were books and journals and batch-processing computers. Then there were books and journals and batch-processing computers and microfilm and on-line terminals. The choice and the variety are to be welcomed, and the challenge to the librarian's or information officer's skill in knowing which tool to use to get the required information accurately, quickly and economically is a

challenge that should be welcomed. On-line terminals are an additional tool in the world of bibliographic information; let us use them in the wisest and most efficient manner"[49].

7.2.7 Future Developments

A brief look will be taken at IR developments which are already in evidence in some organisations and likely to become more widespread in the very near future. Therefore, "paperless information systems" and the like will not be considered. The subject can be pursued in a recent book by Lancaster[50].

- More of the same – more data bases, more systems, longer service hours, faster printout service, lower prices per search.
- More SDI facilities. Already available for example with the *NTIS, Chemical Abstracts* and *PASCALINE* data bases (ESA/IRS).
- More on-line document ordering. Already available for example with *NTIS* and *PASCALINE* (ESA/IRS).
- More data bases with abstracts.
- Computer aided fact and knowledge retrieval as well as references and data retrieval.
- Low cost telecommunications networks for European on-line users. This is the aim of EURONET (Fig.21) which when fully implemented will have the same potential for inexpensive IR as the sophisticated North American networks.
- Standardisation of search commands. SESAME, the Common Command Language of DIANE (Direct Information Access Network for Europe – the intellectual side of the system as opposed to the telecommunications aspect – EURONET) is an example. ESA/IRS is a host on EURONET and can be searched using SESAME as well as the existing command language.
- Multilingual data bases with automatic vocabulary switching.
- Automatic data base selection.
- Application of search strategies to several data bases simultaneously instead of having to search one at a time. Bibliographic Retrieval Services (BRS) have the CROSS DATABASE feature which enables all data bases on the system to be searched or particular ones can be selected.
- Automatic log on procedures. With some 20 DIANE host computers and 150 data bases, on EURONET, a terminal with a memory will be a necessity to relieve the searcher of the chore of remembering passwords and carrying out the correct log on procedures.
- Widespread use of microcomputers. Within the last 2-3 years microcomputers which use little electricity, require no special air-conditioned environments and which are portable have become available for little more than the cost of a colour television receiver. Many of these machines could function as on-line terminals and could be used, as noted above, to perform automatic log on procedures and to reformat citations retrieved during a search (7.2.4 above). Greater use of microcomputers in IR will be feasible when inexpensive, fast-access, mass data storage devices (disc systems) are available and this is likely to occur in the near future.

8. OBSERVATIONS

This Section of the Manual has outlined the principles on which information retrieval is based and examples have been given of indexing systems based on these principles. Human judgement and experience are essential in deciding the most appropriate system for particular applications.

The availability of computerised IR systems on a "dial up" basis is to be welcomed in that it enables even the smallest library unit to have rapid access to the world's published output of scientific and technical literature.

The traditional "reference interview" between the librarian/information officer and the requester is even more important in order to find out exactly what is needed and to make the best use of comparatively costly computer connect time.

Finally, whatever may be the arguments in favour of standardising practices in library and information units, there will still be a need for the skilled intermediary to construct local and tailor-made schemes for his organisation and to sympathetically interpret his requesters' needs in order to deliver to them the appropriate information. Knowledge of techniques is important; equally important are the interpersonal skills to use these techniques to the best advantage.

o switching node
▷ terminal access point
═ 48 kbps line (high speed)
— 9.6 kbps line

Fig.21 EURONET

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APPENDIX A

A NOTE ON SPECIALISED INFORMATION CENTRES

1. INTRODUCTION

When describing the input stage of a model IR system, passing reference was made to the criteria for selecting documents to be included in the system (1.4.1 above). Obviously only documents on subjects with which the library unit's organisation is concerned will be selected for inclusion; but beyond this, there is not usually much in the way of qualitative evaluation made. All AGARD or NASA scientific and technical reports in certain subject fields may be collected, but librarians and information officers do not normally make judgements about the excellence or otherwise of the documents. Nor do most library units involve themselves in the production of new literature by synthesising and repackaging the existing literature. At most, they produce indexes and abstracts to try and control the large output of books, conference proceedings, journals and scientific and technical reports which all contribute to the so called "information explosion". Perhaps the term "information explosion" is a misnomer and we should refer to a "publications explosion" instead. How many of the thousands of documents added to libraries and information centres contain worthwhile information as opposed to low-grade research? Which items contain work of real merit and who is qualified to make such assessments?

2. DEFINITION

Specialised information centres are a means of coping with the large output of publications and they are concerned with the analysis and communication of highly specialised technologies. A specialised information centre (also called Information Analysis Centre – IAC) is: "an organisation directed towards the collection of technical information and data in a specific area of effort and its evaluation and filtering into a form of condensed data, summaries or state-of-the-art report"[1].

3. BRIEF HISTORY

Specialised information centres have a long history in the US where several were set up in the nineteenth century. After 1940 there was a rapid increase in the number of such centres. In the mid-1960s the term Information Analysis Centre (IAC) became common with the emphasis on the *analysis* or evaluative function. In 1963, the Weinberg report[2] gave formal identity and provided an impetus to the establishment of IACs and since that date they have proliferated. The exact number of IACs is not known and there are estimated to be about 200. In the UK the first specialised information centres were set up in the mid-1960s with financial support from the Department of Education and Sciences Office for Scientific and Technical Information (OSTI). Martyn[3] has written a detailed description of four such centres with the aim of providing criteria for evaluating the cost-effectiveness and usability of their services.

4. EXAMPLES OF SPECIALISED INFORMATION CENTRES

There are great variations in the organisation of such centres and in the services they provide. Following are two examples of centres in the US and the UK:

- *Electronic Properties Information Centre (US).* Established by US Air Force in 1961 to provide expert source of information and data on the electronic, optical and magnetic materials of value to the Department of Defense. The centre, now located at Purdue University, identifies, collects, catalogues, analyses and correlates unclassified references concerning electronic properties and includes journal articles, reports, books, theses, patents, standards and specifications and private communications. Abstracting and indexing journals are also scanned. Documents collected are stored on microfiche and subscribers can buy copies. Comprehensive and critically analysed compilations of the electronic, optical and magnetic properties of materials are produced in the form of data sheets and state-of-the-art surveys. Literature searches are carried out for a fee.
- *Mass Spectrometry Data Centre (UK).* Established in 1966 at the Atomic Weapons Research Establishment (AWRE) by OSTI with terms of reference which included: the production of a current awareness bulletin; setting up a collection of spectra; devising methods of identifying unknown substances using computerised techniques. In 1978 the activities of the Centre were transferred to the United Kingdom Chemical Information Service (UKCIS) at Nottingham University. Services produced by the Centre include the following: *The Mass Spectrometry Bulletin* which is a monthly current awareness bulletin with bibliographic details of recently published documents dealing with mass spectrometry. (A cumulative magnetic tape version of the *Bulletin* dating back to 1966 can be bought by organisations wishing to use it on their own computers); Mass Spectral Data Sheets – mass spectra are collected and distributed on a world-wide basis and advice is received from an International Advisory Committee for Mass Spectral Data which has representatives from the USA, France and Germany as well as the UK. UKCIS also carries out tutorial sessions on the activities of the Centre and techniques for searching mass spectral data and literature.

Further examples of centres can be found in an excellent, short book by Harvey[4] which also examines the criteria, problems and philosophy for establishing such centres.

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Section 8

DISSEMINATION PRACTICES

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ABSTRACT

This section addresses the dissemination of Scientific and Technical (S&T) Information to the scientific user community. An overview of the area is presented followed by discussions of initial and secondary distribution. The need for automated support of the processes is described. Included as an appendix are the results of survey responses from a number of National and International Technical Information Centers. These responses detail charters, data bases, practices and operations of the responding S&T Information Centers. Most of S&T information points surveyed are concerned with unclassified, unrestricted material. The exceptions were usually those which interfaced with a well defined user community readily subject to registration and control, and able to demonstrate a "need to know" such as contractors working on defense contracts.

CONTENTS

		Page
1.	INTRODUCTION	45
2.	PRIMARY DISTRIBUTION	45
	2.1 Batch Retrieval	45
	2.2 Combined Service	45
3.	SECONDARY DISTRIBUTION	46
	3.1 Machine Readable Data Base Distribution	46
	3.2 US Services	46
	3.3 European Services	47
4.	DOCUMENT RETRIEVAL	47
5.	TRANSLATIONS	47
6.	USER STUDIES	48
7.	ACCESS RESTRICTIONS	48
	7.1 NATO Agreement	48
8.	COPYRIGHT	48
9.	FOREIGN ACCESS	49
10.	FUTURE DEVELOPMENTS	49
BIBLIOGRAPHY		50
ACKNOWLEDGEMENTS		50
APPENDIX A – List of Various National and International S&T Information Centers with Questionnaire Responses		51
APPENDIX B – Document Requests Procedures (Design of Forms, Processing of Requests)		112

1. INTRODUCTION

1.1 This section of the manual deals with initial distribution of material, specific requests for material, guidelines on sensitive aspects and conditions of release. In preparation for this section, a questionnaire was sent to a number of National and International S&T Information points. Some operate in the classical library sense, some as national repositories and others as specialized and/or national retrieval centers. Responses were of this same general mix. Because of this, no attempt was made to matrix the responses. The results of the survey are included in Appendix A with is split into 20 separate parts – one for each of the contributing centers. It should be noted that two defense repositories, the UK Defence Research Information Centre (DRIC) and the US Defence (DTIC), operations are presented in depth in order to provide an insight into their particular mode of operations (see Appendix A, Parts 5 and 7). Detailed descriptions are given showing how DRIC and DTIC handle user registration, requests for documents, document control and recording, and specific forms used to record the processes involved.

1.2 The task facing the newly operating and even the well established S&T information center is particularly onerous because of the proliferation of S&T information. In excess of 6,000 to 7,000 articles and reports are produced each working day, a total of more than 2 million scientific writings a year. Looked at from a different point of view, this would be as many as 20 million published words per working day. Still another measure of the problem is that "the present world stock of S&T articles numbers at least some 20 to 30 million titles. If the books are also taken into account you would add another 100 million unique titles to the collection.[2] While some manual retrieval operations and in-house cataloging and abstracting can still be found, it is in the minority among those surveyed. Evidently, even the smallest S&T Information activity can well afford automation when weighed against the inefficiencies and cost of a manual operation and the need for creditable searches of S&T information in response to user needs.

2. PRIMARY DISTRIBUTION

Essentially this is the initial sending of a document from its originator or publisher to more than one destination, for example, issuing a technical report in accordance with a distribution list. Primary distribution can take many forms dependent upon the type of S&T information activity, size, and audience served.

The survey disclosed activities ranging from no activity (BLLD), through profiled microfiche and/or hard copy services (DTIC), (NASA), (NTIS), subscription sales (GPO), and announcement services such as: NTIS's "Tech Notes" and "Abstract Newsletter"; NASA's "Selected Current Aerospace Notices"; NTC's "Monthly Translations Register Indexes" and GPO's "Selected US Government Publications".

These all represent effective means of making their users aware of new material entering the system. The publications are broad but the user need only to peruse a relatively small portion of the information spectrum to keep abreast of state-of-the-art S&T information. Most of the announcement services are the product of an existing mechanized system serving to catalog and abstract the material for later retrieval.

A variation of this approach is known as SDI or a selective dissemination of information. Through the use of batch processing on computers, SDI was made possible. SDI is a system of notification of articles that are relevant to an individuals information needs. This method depends on a "user profile" which describes the types of articles in which the researcher is or is not interested and is usually a search of material entering the data base since the previous search.[12] (Also see Section 6 of this Manual.)

2.1 Batch Retrieval

The batch retrieval services in Europe and Canada have long been dominated by current awareness services, SDI rather than retrospective services. Retrospective searches are usually one time searches for any specified time span of material. Their popularity is not surprising because such searches are much less expensive than the larger retrospective search[7].

2.2 Combined Service

It is found that by combining SDI or current awareness service as offered by DTIC, NASA, and NTIS with microfiche SDI services that initial distribution of information can be accomplished expeditiously. By the time the user is aware of information availability, at least through formal announcement, the local S&T Information Center has the microfiche copy waiting for the requestor.

This approach has been used very successfully by the Rome Air Development Center (RADC)* Technical Library for some years. RADC relies upon two current awareness services plus scheduled DTIC bibliographies to publicize document availability (NTIS/NASA), and two SDI microfiche services (DTIC/NASA) to provide the documents. This combination of products satisfies a high percentage of initial or primary distribution S&T needs. A further input to the technical library resources is the result of paper copy distribution of reports generated primarily within the US DoD. Armed with these resources, either microfiche or paper copy is provided to the requestor dependent upon his preference.

* RADC is a research and development activity in support of the United States Air Force, Air Force Systems Command, Electronic Systems Division. The Technical Library services approximately 800 users.

3. SECONDARY DISTRIBUTION

This is defined as the response of an S&T Information Center to a request for a specific reference or, the process by which a specific request identifies pertinent material for retrieval. A frequent problem encountered by S&T Information Centers is that documentation requests are received which lack sufficient information to enable speedy processing to be achieved. In order to encourage the orderly presentation of adequate information, it is of considerable assistance if a standard document request form is used. Some useful guidelines on the design of forms and the processing of requests has been provided J.C.Dunne of DRIC and these are given in Appendix B.

Widespread use of retrospective or interactive information retrieval became possible after the advent of commercial timesharing computer systems and greatly assists secondary distribution activities. This method differs from SDI in that while SDI is used to maintain "current awareness" in a given area, interactive systems are used primarily for retrospective searching of a given topic.

The data bases used in the two types of systems generally contain the same information. The data bases contain bibliographic information on articles, books, conference processings, reports and so forth, are sometimes accompanied by abstracts, but do not contain full text[12]. Norton has comprehensively described information retrieval techniques in Section 7 of this Manual.

The use of online literature searching, of abstracting, indexing and other services has grown very rapidly in recent years and with this growth searching costs have been reduced considerably. An example of this is the experience of Bell Laboratory Libraries where in 1975, 302 online searches averaged US$44.00 per search and in 1976 there were 1247 searches at an average cost of $27.50. Reduced terminal and communications network charges make this mode of operation even more cost effective to use online searching with its high speed and comprehensive coverage, than to do manual searching requiring high labor costs[6].

In 1976 there were 33 million bibliographic references available for online searching; in 1977 this had grown to 50 million. It was estimated that over 2,000,000 online searches were performed in 1977, and online search activities are growing at a rate of over 40% per year. The growth rate is nearly matched by the number of data bases being provided. The Lockheed "Dialog" service for example grew from 18 data bases in 1974 to over 70 in 1978.

3.1 Machine Readable Data Base Distribution

Distribution of machine readable bibliographic data bases are as shown in Table 1 (prepared 1978):

TABLE 1

(See 7 in Bibliography)

Source	*Number of Data Bases*	*Number of Records (Million)*
	No (%)	No (%)
US	208 (57)	58 (82)
Non US	154 (43)	13 (18)
TOTAL	362 (100)	71 (100)

3.2 US Services

In the United States there are four major providers of online bibliographic search services to the general user; these provide access to a variety of bibliographic files. Each of these services has made arrangements with several or many data base producers to provide online search services for their data bases as shown in Table 2:

TABLE 2

Major US Online Bibliographic Search Services
(See 7 in Bibliography)

Search Service	*Retrieval System*	*No. of Bibliographical Data Bases (Jan 78)*
National Library of Medicine	ELHILL	18
Lockheed Information System	DIALOG	70
System Development Corp (SDC) Search Service	ORBIT	40
Bibliographic Retrieval Service	STAIRS	15

In addition to these four, two were found that serve controlled audiences exclusively, namely: the DTIC/RDT&E on line system serving DTIC registered users and, NASA/RECON serving NASA scientists, engineers and contractors.

Typically the S&T information center contracturally arranges to use the particular bibliographic search service of interest. Access is gained via commercial communication networks or dedicated telephone service. Lockheed/DIALOG for example requires access through WATS, TYMNET or TELNET. In the US, entry is gained through local service nodes usually providing a 300 baud line which equates to approximately 30 characters per second. A suitable terminal must be provided by the user from the many compatible devices available commercially. Either a teletype or video display terminal may be used. Telephone interface devices must also be provided. Search output can be printed locally or remotely in batch. Changes for access to the data of interest includes the associated communication charges by connect hour. Rates for DIALOG data base access vary from $25 to $150 per hour. The flat rate communication charge is added to the monthly billing. You pay only for what you use and there is no fixed charge.

3.3 European Services

In Europe the ESA/ESRIN Services are used extensively. Others include the BLLD's BLAISE, DRIC's DOORS, and IAEA's INIS. These were the ones generally identified as a result of the survey. In addition, there were several that served internal needs of the responders. A number of points responding were also using commercially available data bases such as Lockheed/DIALOG and SDC/ORBIT. It was found that even the smallest S&T Information Centers responding to the survey relied upon such services. Personal experience has proven that such services are a necessary part of a successful operation. RADC offers DTIC/RDT&E, NASA/RECON and Lockheed/DIALOG supplemented by on-line ordering of DTIC and some NTIS material. At RADC we have found that, while mechanized data base access does increase retrieval activity, it cuts down on search time; increases user confidence in the operation; and is well worth the investment in the new skills required and the cost of the service.

Personnel and funding determine whether online searches comes alive: the attitude and support of management, the library director and the head reference librarian are crucial to the success of the venture. Unless all are firmly committed to work for and support online searching, the probability of success is at best marginal. The personalities and commitment of individual librarians are also key factors[7].

It should be noted that:

- Tests of online and batch searches of the same data base show that online searches are both more effective and more expensive[11].
- According to Hersey[4] approximately 60% of the ongoing research information systems identified in a recent world wide inventory are operated as a part of a general information system. The concept of combining ongoing research information with technical report or bibliographic information has been used to enhance the value of a publication which otherwise might contain only one or the other type of information. An example is NASA's Scientific and Technical Aerospace Reports as published semi-monthly.
- McCarn[7] has found from a study conducted by Summit and Ferschain that the estimated total cost of providing an online reference service is US$13,500 per year of which $3,000 is a fixed cost even if no searches are done. The remaining $10,500 covers 30 searches per month, or about $29 per search.

4. DOCUMENT RETRIEVAL

It has been stressed that automation makes for effective operation of an S&T Information service but, there are inherent difficulties. In the classical manual mode of operation, the data base is both cataloged and available on site, and therefore presents no great problem to either the S&T information service or the user. The user may think he is recovering all there is to know about a subject in response to an inquiry, and the S&T information service usually doesn't voluntarily extend searches beyond their own holdings. Introduction of automation and access to external data base search systems upsets this balance, and exposes both the user and the service to a seemingly endless array of options. The result is that the user can identify material that the S&T Information Service may be ill equipped to recover. Also, since the machine-readable data bases are generally comprehensive, the identification of items in esoteric journals and/or languages is more common than had been true for manual searches.

This exposes one of the major faults of data base search systems, in that they identify articles but often fail to provide a way for the user to obtain them. Some work is being done in improving document delivery and in some cases guides prepared such as the one by Piternich for users of the Canadian information retrieval system entitled, "How to Get What you Don't Have! A Guide to Obtaining Loans, Photocopies or Microcopies of Sci-tech Publications"[9,11]. AGARD Lecture Series No.69 on "How to Obtain Information in Different Fields of Science and Technology – A Users Guide" is another source of information concerning information sources and retrieval methods[1].

Many S&T Information Services offer prepaid coupons or deposit accounts. It is recommended that these be set up with potential information suppliers in advance so that user needs can be expeditiously provided for once the document source is identified.

5. TRANSLATIONS

A comprehensive search of large data bases may well yield half the results in foreign language papers which are harder to access. The participation of a greater number of countries of the world in the further development of science

and technology will probably make the language barrier stronger instead of weaker. In many cases the scientists of these countries will not use international languages for the communication of their research results. When searching through literature, the appearance of foreign material happens more often now than before because of the increased use of data bases. In these data bases the literature listed is not limited to a certain area or a certain language. According to H.Collier (cited in Reference 13) who carried out a count between the years 1970 - 1975, in the Institute for Scientific Information data base, the USA Journals account for 37% of the journals, European Journals for 54% and the rest of the world for 9%.

In order to prevent duplication of very expensive and very time consuming translation effort and to insure a better dissemination of existing translations, thus promoting international and national co-operation, several networks of translation agencies, holding centers and international clearing houses have been developed in the USA, Europe and Latin America[13]. ITC in Delft and NTC in Chicago are two of these centers. Wherever possible the use of such services is suggested in lieu of establishment of formal translation service programs by the new S&T information center.

The survey however did reveal a number of secondary translation activities: CEDOCAR translates for Internal needs, CNDST does translations, BLLD has a translations program through its Lending Division, TIC translates for DOE needs, DRIC offers a free lance service, and ESA has a translation program which supports NASA.

6. USER STUDIES

It has been estimated in a report produced in the USA Office of Science and Technology within the Executive Office of the President that a ten percent gain in scientific and engineering productivity might be possible with improved information systems. Although considerable progress has been made in the management of technical information, a great deal more needs to be done. Better management, coordination and participation with other information systems will improve the effectiveness of all technical information programs throughout the research and development community without increasing over all costs. DTIC for example has reached a "crossroad" in its evolution as a major S&T Information Center. As a consequence, formal studies have been conducted to synthesize the predictions of user requirements as well as the forecasts and trends in information technology, into a set of realistic, well conceived and documented technical objectives for DTIC in the next decade[10].

7. ACCESS RESTRICTIONS

A study made of a typical US DoD facility revealed that over 50% of its S&T literature was security classified or having some form of controlled distribution. This information is usually subject related and only available to those members of the user community having proper security access levels with accompanying "need to know". This is not the type of material included in the large machine searchable data bases. An exception would be the DTIC and some of NASA's collection. In addition to security, S&T information is sometimes limited by sensitivity. For example, all US DoD generated reports must be reviewed for public release. Reasons for restriction of dissemination in addition to security can be; information was received from a foreign source with request not to release further, proprietary information provided by the generator for use by the US Government only, test and comparison of manufacturers products, test and evaluation of military hardware, and evaluation of contractor performance. Such documents are stored in DTIC and are only released within authorized channels for use by the Government and then only with the consent of the office imposing the dissemination restriction. Other repositories such as DRIC and DSIS, have similar access restrictions. A number of S&T information centers require user registration and an example of a form for this purpose is shown in Appendix A-7. Most Defence orientated centers operate a continuous program for reviewing documents so that wherever possible these are down graded or delimited and made available to the public. Sometimes this is through a separate repository such as the DTIC/NTIS and DRIC/TRC* relationships seen in the USA and UK respectively. A more comprehensive description of procedures for classified and controlled access documents is given in Section 10, Vol.IV of this Manual.

7.1 NATO Agreement

NATO has formulated an agreement concerned with such matters. The scope of the agreement covers the communication and use of proprietary technical information for defense purposes when the communication of the technical information occurs between governments, between NATO organizations or between governments and NATO organizations or individuals. All communications of technical information under this agreement are made for information purposes only. Also, transmission of classified information shall be only through channels approved by government parties involved in the communication or receipt of such information[8].

8. COPYRIGHT

Historically copyrights have been used to protect the interests of the owners. This protection is limited in that the owner of copyrighted material does not have the right to refuse to sell his work. This limitation is based on the premise

* Department of Industry Technology Reports Centre.

that the owner of the copyrighted work has a monopoly and can earn monopoly profits. However copyright is not the only method of protecting property rights that is used in information data banks. In their dealings with computer system operators, the producers of several of the computer-readable bibliographic data bases rely more on their being the sole source of periodic updates than on copyrights.

The existence of economical electronic storage of textual and reference material makes the problems of monitoring usage and charging fees more difficult than otherwise would be the case. Let us adopt the, sometimes imperfect, analogy that is often made between a computer data bank and a "conventional" library. In each, input, storage, and retrieval exists as identifiable functions. In the library situation, payment is made for the material – books, serials, etc. – as the ownership of a tangible item changes once on input. (There is some pressure for payment of an additional sum to copyright holders based on the borrowing of "their" works from public libraries. The UK has recently adopted such a system on a limited scale.) However in computer systems, there need not be the purchase of any tangible items to obtain material for the input operation. Although the technical and economic realities permit detailed monitoring and record-keeping for the computer systems, the difficulties of enforcement are greater.

Suitable contract arrangements have been developed to cover, for instance, the agreement entered into by an abstracting and indexing service and a computer system operator such as Lockheed or SDC. These vary considerably – some include payments from the computer system to the abstracting and indexing service for each citation the user obtains on-line or off-line in addition to the payments for the data base and updates. But as the number of commercial and private computer-based systems increases, it may be beneficial from a cost and efficiency basis to standardize the basis for payments to the generators of the data bases.

Another part of the copyright quandary revolves around the abstract itself. For example, the American Institute of Physics asserts that it owns the copyright of all the abstracts published in its journals. There have been several recent discussions of the effects of and problems associated with universal enforcement of these proprietary rights[3].

9. FOREIGN ACCESS

In some replies to the survey (Appendix A), it was found that foreign access is not permitted. In others it takes place through formal channels such as embassies or designated information services resident in the host country. In the case of the USA, Belgium and UK unrestricted contact was found to be permitted through a public point of contact (NTIS, CNDST, TRC).

10. FUTURE DEVELOPMENTS

It has been said that "the future of the knowledge industry and all its components, without exception, is closely related to the automation of information". The unanimous view of various researchers is that during the decade 1980-1990 automated information will entirely replace the more or less adequate manual processes used at present for transmitting and disseminating knowledge. We are moving rather rapidly and quite inevitably towards a paperless society. Advances in computer science and in communication technology allow us to conceive of a global system in which reports of scientific discovery and technological development are composed, published, disseminated and used in a completely electronic mode[5].

In this respect, RADC is implementing an experimental office automation system giving the scientific worker direct access to the computerized world, which could include international data bases, via an interactive display terminal and networking. Terminal users will be able to interrogate several data bases directly to identify S&T information of interest. This is being done using a virtual command language so that the computer will perform the interface necessary to access the data bases in the users primary command language syntax.

Since the basic S&T information will be documented in this same electronic system, it may be possible in the future to dispense with the large national repositories as we now know them and retrieve the information electronically directly from the source files. The source file catalogs could be maintained in turn by a smaller specialized information center that the users would approach first. Recovery of material would be by indicating the need and the virtual process would do the rest without the user knowing that it may have been retrieved from yet another data base.

As the user becomes a direct part of the S&T retrieval process, costs of access terminals are reduced, communications enhanced, memories reduced in both size and cost, new methods developed for entering and abstracting information, or full text search becomes possible, a whole new concept for S&T information handling will emerge.

In planning new centers or in studying the old, the impact of this new or projected technology must be seriously considered and analyzed to avoid rapid obsolecense of the S&T Information system no matter how advanced it may seem at the present.

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APPENDIX A

LIST OF VARIOUS NATIONAL AND INTERNATIONAL S&T INFORMATION CENTERS WITH QUESTIONNAIRE RESPONSES

DISSEMINATION PRACTICES – FORMAT OF QUESTIONNAIRE

(a) *Charter or description of facility and service.*

(b) *Sources of data and material distributed.*

(c) *Size of collection(s).*

(d) *Listing of data banks – include description.*

(e) *How is material accessioned and retrieved?*

(f) *National policies affecting dissemination.*

(g) *Initial distribution policy and methods.*

(h) *Secondary distribution policy and methods.*

(i) *Restrictions on dissemination.*

(j) *Who can access the information?*

(k) *Method of domestic access.*

(l) *Method of foreign access if permitted.*

(m) *User registration method if required.*

(n) *Announcement media.*

(o) *Is material sold or loaned or both?*

(p) *Cost and method of payment for material and services.*

(q) *Request and registration forms (samples).*

(r) *Promotional material available.*

(s) *What aspects of your operation are automated?*

(t) *Guidelines for access to sensitive material.*

(u) *Conditions for release of material.*

(v) *Translation services and material availability.*

(w) *Customer relation and user need services.*

(x) *Future plans and developments.*

(y) *Staff and training (optional).*

(z) *Comments.*

Appendix A Attachment Number	*Abbreviation*	*S&T Information Activity*
1	AIAA	American Institute of Aeronautics and Astronautics Inc. Technical Information Service 750 Third Avenue New York, NY 10017, USA
2	BLLD	British Library/Lending Division Boston Spa Wetherby West Yorkshire, LS237BQ, UK
3	CEDOCAR	Ministry of Defense General Delegation for Armament Directorate of Research, Studies and Technology Documentation Center for Armament 26, Boulevard Victor – 75996 Paris Armees, France
4	CNDST	Centre National de Documentation Scientific et Technical Bibliotheque royale de Belgique Boulevard De L'Empereur 4 1000 Bruxelles, Belgium
5	DRIC	Defence Research Information Centre Station Square House St. Mary Cray Orpington, Kent BR5 3RE, UK

Appendix A Attachment Number	*Abbreviation*	*S&T Information Activity*
6	DSIS	Defence Scientific Information Service National Defence Headquarters (NDHQ) 101 Colonel By Drive Ottawa, Canada K1A0K2
7	DTIC	Defense Technical Information Center Cameron Station Alexandria, Va. 22314, USA
8	TIC	Department of Energy Technical Information Center (TIC) P.O. Box 62 Oakridge, Tennessee 37830, USA
9	ESRIN	European Space Agency ESRIN-Information Retrieval Service via Galileo Galilei 0004 Frascati, Italy
10	FFA	The Aeronautical Research Institute of Sweden P.O. Box 11021 S-161 11 Bromma, Sweden
11	FOA	Forsvarets Forskning San Salt National Defense Research Institute S-10450 Stockholm, Sweden
12	–	Helsinki University of Technology Library Otaniementie 9 SFO 2150 ESPOO 15, Finland
13	IAEA	International Atomic Energy Agency Kavntner Ring 11, P.O. Box 590 A-1011 Vienna, Austria
14	ITC	International Translations Centre 101 Doelen Straat Delft, The Netherlands
15	RITL	Kungl Tekniska Hogskolans Bibliotek Royal Institute of Technology Library S-100 44 Stockholm, Sweden
16	NASA	National Aeronautics and Space Administration Scientific and Technical Information Facility P.O. Box 8757 Baltimore/Washington International Airport MD 21240, USA
17	NTIS	National Technical Information Service Springfield, Va. 22161, USA
18	NTC	National Translations Center The John Crerar Library 35 West 33rd Street Chicago, Illinois 60516, USA
19	SSIE	Smithsonian Science Information Exchange Inc. Room 300 1730 M Street, Washington D.C. 20036, USA
20	GPO	US Government Printing Office Washington D.C. 20402, USA

APPENDIX A-1

American Institute of Aeronautics and Astronautics Inc. (AIAA)
Technical Information Service
750 Third Avenue
New York NY 10017, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
American Institute of Aeronautics and Astronautics – Technical Information Service.

(b) *Sources of data and material distributed.*
All published literature in space sciences and all allied fields analyzed, abstracted and indexed in our semi-monthly publication "International Aerospace Abstracts".

(c) *Size of collection(s).*
22,000 books; 2000 pamphlets; 40,000 reports; 1600 current periodical titles; 750,000 microfiche.

(d) *Listing of data banks – include description.*
NASA RECON.

(e) *How is material accessioned and retrieved?*
All cited material is accessioned with unique abstract number; abstracted, indexed and published in IAA – all items are also input into the NASA data base. Material can be retrieved manually by use of IAA or by machine using NASA RECON.

(f) *National policies affecting dissemination.*
IAA is available to all on a subscription basis. RECON is available to selected users through NASA.

(g) *Initial distribution policy and methods.*
As above.

(h) *Secondary distribution policy and methods.*
As above.

(i) *Restrictions on dissemination.*
No restrictions on published sources; limited distribution on data base (handled by NASA).

(j) *Who can access the information?*
Available to all via Technology Utilization Centers, AIAA etc. for machine retrieval – published issues for manual retrieval.

(k) *Method of domestic access.*
As above.

(l) *Method of foreign access if permitted.*
NASA data base is available in Europe through ESA.

(m) *User registration method if required.*
Access to RECON is limited to users with assigned passwords.

(n) *Announcement media.*
IAA; STAR (for report section of NASA data base).

(o) *Is material sold or loaned or both?*
IAA is available on subscription; all material cited in IAA is available in photocopy form at $6.00 per item up to 20 pages and an additional 25c per page thereafter – microfiche is available for non-copyright items at $2.50 per fiche; Loans are available only to the NASA Centers and Technology Utilization Centers.

(p) *Cost and method of payment for material and services.*
Costs as above; deposit accounts and coupon system in effect.

(q) *Request and registration forms (samples).*
No specific forms are required – telephone calls, telegrams, letters, and personal visits are all accepted.

(r) *Promotional material available.*
All available promotional material attached.

(s) *What aspects of your operation are automated?*
Input and retrieval into and from the NASA data base – a major part of the production of IAA.

(t) *Guidelines for access to sensitive material.*
Operation is limited to "open literature".

(u) *Conditions for release of material.*
Not applicable.

(v) *Translation services and material availability.*
All cited material is available – translation of other than sufficient for abstract is not offered.

(y) *Staff and training (optional).*
Total staff 80 – library staff 10.

APPENDIX A-2

British Library/Lending Division (BLLD)
Boston Spa Wetherby
West Yorkshire, LS23 7BQ, UK

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The British Library Lending Division exists to provide a loan/photocopy service to any library in the UK prepared to abide by the regulations relating to registered users. The service is also extended to libraries abroad, which may obtain photocopies direct and loans through national centers.

(b) *Sources of data and material distributed.*
Worldwide collection of material (periodicals, monographs, microforms, etc.) in all subject fields; supply of literature "on demand" only.

(c) *Size of collection(s).*
The stock of the Lending Division comprises of over 3 million volumes of books and periodicals, and over 2¾ million documents, mainly reports, in microform. The main criterion for acquisition is that the items are likely to be wanted on interlibrary loan. Serials are collected irrespective of subject and language; 51,000 current titles are received. English language monographs, wherever published, are acquired comprehensively, while foreign language monographs are bought on a selective basis. Other categories taken include non-classified report literature, conference proceedings and British official publications.

(d) *Listing of data banks – include description.*
British Library Automated Information Service (BLAISE); British Library Index of Conference Proceedings received at BLLD (to be included shortly in BLAISE) UK input to MEDLINE.

(e) *How is material accessioned and retrieved?*
Mainly manual input, some mechanised retrieval.

(f) *National policies affecting dissemination.*
Covered in (b) and (c).

(h) *Secondary distribution policy and methods.*
Distribution of British Library Research and Development Dept. Reports (BLRD Reports) on microfiche.

(i) *Restrictions on dissemination.*
Within copyright laws.

(j) *Who can access the information?*
Restricted to our own publications: acknowledgement requested.

(k) *Method of domestic access.*
Only to registered users, mainly libraries and information centers. Telex requests accepted (see 1).

(l) *Method of foreign access if permitted.*
Photocopies, subject to copyright, available on prepaid photocopy form/coupon systems; loan available only through national centers. Telex requests accepted, provided these conform to rules and formatting instructions.

(m) *User registration method if required.*
UK users, write to Loan Enquiries, from elsewhere write to International Lending Section.

(n) *Announcement media.*
1. BLLD Announcement Bulletin (A guide to British Report, Translations and Theses).
2. Index of Conference Proceedings Received.
3. Interlending Review.
4. Current Serials Received.
5. Journals in Translation.
6. Serial Publications of the European Communities and its Institutions held by the BLLD.

(o) *Is material sold or loaned or both?*
Loaned, and photocopies provided within copyright laws.

(p) *Cost and method of payment for material and services.*
On prepaid form/coupon system.

(q) *Request and registration forms (samples).*
Specimen request forms enclosed.

(s) *What aspects of your operation are automated?*
Serial ordering and acquisition; partial automation of monograph acquisition; some loan/photocopy requests received by telex processed on minicomputer.

(t) *Guidelines for access to sensitive material.*
No sensitive material held at BLLD.

(v) *Translation services and material availability.*
The Lending Division maintains a translations index to the nearly ½ million translations in stock at Boston Spa. Most are ad hoc translations of mainly scientific/technical articles translated from Russian, Japanese, difficult others, and also Western languages. The LD cooperates with the National Translations Center, Chicago in providing an exchange of translations and information about them. In cooperation with the International Translations Centre, Delft, "Journals in Translation" was recently produced. The LD provides an input to NASA of translations of interest to the aerospace community.

In addition, the LD has a translating program under which to date some 10,000 ad hoc translations have been made.

(w) *Customer relation and user need services.*
Loan Enquiries Office (for UK users); International Lending Section (for enquiries from outside UK); External Relations and Services Section.

(x) *Future plans and developments.*
To extend the Automatic Document Request Service (ADRS), now available to BLAISE users, to users of other host data bases.

(y) *Staff and training (optional).*
760, 130 of whom are professionally trained.

APPENDIX A-3

CEDOCAR
Ministry of Defense
General Delegation for Armament
Directorate of Research, Studies and Technology
Documentation Center for Armament
26, Boulevard Victor – 75996 Paris Armees, France

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The directorate of CEDOCAR maintains three sub-directorates: scientific and technical information, technical equipment, and administration. Facilities consist of two media libraries, one referral library, and a computer for information processing.

(b) *Sources of data and material distributed.*
Magnetic tape of descriptions compiled by CEDOCAR, including foreign tapes acquired by purchase; purchase of primary documents and subscriptions to magazines.

(c) *Size of collection(s).*
Diverse collections of various sizes.

(d) *Listing of data banks – include description.*
The CEDOCAR undertook coordination of data bases of the General Delegation for Armament (DGA); about 15 at the present time, particularly in the area of materials, oceanography, thermodynamic data, ...

(e) *How is material accessioned and retrieved?*
Standard procedures for retrieval of descriptions on terminal, and terminal-supported research.

(f) *National policies affecting dissemination.*
Secondary documents reserved for agencies approved by the Ministry of Defense.

(g) *Initial distribution policy and methods.*
Categories not used in France.

(h) *Secondary distribution policy and methods.*
As in (g).

(i) *Restrictions on dissemination.*
See reply under (f); the CEDOCAR looks for introductory notice "Limited Distribution" (notice "Unclassified Limited").

(j) *Who can access the information?*
Approved users, members of approved agencies.

(k) *Method of domestic access.*
Special access cards issued to users after investigation.

(l) *Method of foreign access if permitted.*
Special access cards (especially for foreign students in Armament Schools) issued after investigation.

(m) *User registration method if required.*
"Users File" is consulted.

(n) *Announcement media.*
Background research, selective dissemination of information.

(o) *Is material sold or loaned or both?*
Secondary documents available for sale; primary documents available for lending or on-site consultation.

(p) *Cost and method of payment for material and services.*
Cash payment, or deduction from deposit.

(r) *Promotional material available.*
Special forms to request issuance of access cards.

(s) *What aspects of your operation are automated?*
Retrieval, research, preparation of secondary documents.

(t) *Guidelines for access to sensitive material.*
Department set aside for processing of classified information, service reserved for duly accredited users. The CEDOCAR operates within the framework of Instructions compiled by the Security Authorities.

(u) *Conditions for release of material.*
Users provided with special access cards.

(v) *Translation services and material availability.*
Translation Department; translations carried out exclusively for the internal needs.

(w) *Customer relation and user need services.*
One Division is tasked with maintaining relations with the users.

(x) *Future plans and developments.*
Computer for information processing replaced by a more powerful computer, automation of documentation management services.

APPENDIX A-4

Centre National de Documentation Scientific et Technique (CNDST)
Bibliotheque royale de Belgique
Boulevard De L'Empereur 4
1000 Bruxelles, Belgium

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The CNDST is a R/D information service providing scientists, technologists and engineers with the documentation and information they need for their projects. General multidisciplinary library and science/technology national information center for Belgium.

(b) *Sources of data and material distributed.*
Bibliographical searches and numerical data.

(c) *Size of collection(s).*
Royal Library approximately 4 million books, approximately 30,000 current periodicals, reports, conference papers, etc.

(d) *Listing of data banks – include description.*
1. Own produced data banks and inventories.
2. Data banks received from outside for retrospective and R/D searches.
3. Use of networks: ESA, Lockheed, SDC, etc.

(e) *How is material accessioned and retrieved?*
By classical and automated methods: keywords and free languages.

(f) *National policies affecting dissemination.*
In this state of development, no direct impact. Some normalization and coordination is foreseen, when EURONET is going operational.

(g) *Initial distribution policy and methods.*
As public service, no limitation. Priorities for advanced academic and industrial research and development.

(h) *Secondary distribution policy and methods.*
General scientific public information and free distribution of documents.

(i) *Restrictions on dissemination.*
Only for classified and restricted documents (controlled distribution).

(j) *Who can access the information?*
Each qualified scientist, engineer, medical doctor or agronomist (advanced research work).

(k) *Method of domestic access.*
Documents: on loan or copies.
Information: on request.

(l) *Method of foreign access if permitted.*
No limitation for foreign access.

(m) *User registration method if required.*
For documents: yes (user card).
For information: obligatory for qualified answers.

(n) *Announcement media.*
Leaflets, seminars, "open doors' and other media (e.g. exhibition, demonstrations, etc.)

(o) *Is material sold or loaned or both?*
Books on loan: some publications are sold (e.g. inventories).
Information is free of charge: only computerized services and copies are charged.

(p) *Cost and method of payment for material and services.*
Prices are scheduled: payments are cash, cheques or international reply coupons.

(q) *Request and registration forms (samples).*
Yes, as well for documents as xeroxcopies, as request for information.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?*
Catalogs, data banks as well as housekeeping activities. National Centre for ESA-IRS.

(t) *Guidelines for access to sensitive material;*
Only with special permission (controlled access and copyrights).

(u) *Conditions for release of material.*
With mutual agreements.

(v) *Translation services and material availability.*
Yes, only for difficult accessible languages (Russian, Slavic language, Japanese, etc.)

(w) *Customer relation and user need services.*
Yes: educational and promotional sections.

APPENDIX A-5

Defence Research Information Centre (DRIC)
Station Square House
St. Mary Cray
Orpington, Kent BR5 3RE, UK

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
DRIC acts as the Master Record Centre for UK Defence reports. DRIC serves the Ministry of Defence Branches and Establishments and organizations with current UK Government defence contracts. DRIC also performs subject searches of scientific and technical report literature and provides copies of announced documents for loan or retention if stock permits. Unlimited reports are held by Department of Industry Technology Reports Centre (TRC) at St. Mary Cray.

(b) *Sources of data and material distributed.*
Mintech Technology Reports Center and Naval Scientific and Technical Information Centre before 1st October 1971 plus all defence controlled and classified reports after that date. DRIC has access to the unlimited reports held by DRIC also has several exchange arrangements with other centers such as DTIC.

(c) *Size of collection(s).*
Total estimated at over 800,000 reports.

(d) *Listing of data banks – include description.*
All classified limited defence reports. Overseas defence reports. US Military Specifications, other US specifications and a number of Commonwealth and other foreign specifications.

(e) *How is material accessioned and retrieved?*
Subject indexed using US Thesaurus of Engineering and Scientific Terms (TEST) plus supplementary terms and other details of the report. Reports can also be retrieved by author and corporate author.

(f) *National policies affecting dissemination.*
Wherever possible the results of UK defence research and development is applied to the civil field. Unclassified restricted reports are scanned for "know how" and released to TRC if possible.

(g) *Initial distribution policy and methods.*
SDI service – MOD staff only. Standard Profile Service similar to SDI but on a broader subject basis.

(h) *Secondary distribution policy and methods.*
Manual search prior to 1970, computer search using DOORS (Defence Oriented On-Line Retrieval System) since 1970.

(i) *Restrictions on dissemination.*
Need to know required.

(j) *Who can access the information?*
Reports from DRIC collection are available to MOD Staff and Defence Contractors on loan; Some copies (paper and microfiche) for retention.

(k) *Method of domestic access.*
Request for documents should always be made on Form DRIC REQ 1. DRIC services available via local technical information officers or librarians.

(n) *Announcement media.*
DRIC Defence Research Abstracts (DRA) journal. Two main editions: MOD Edition (semi-monthly) available to MOD staff only and Contractors Edition (monthly). SDI service standard profiles and magnetic tape.

(o) *Is material solid or loaned or both?*
Loaned.

(q) *Request and registration forms (samples).*
Requests for subject searches should be made on form DRIC/TECHENQ/78/1.

(r) *Promotional material available.*
Yes, a number of leaflets including a newsletter.

(s) *What aspects of your operation are automated?*

DRIC has a RECON terminal to the ESA mechanized information network. Index of DRA is computer produced. DRIC accesses BLAISE (British Library Automated Information Service) and Lockheed Dialog.

(t) *Guidelines for access to sensitive material.*

DRA MOD Edition is confidential discreet, Contractor Edition is restricted.

(u) *Conditions for release of material.*

Need to know and relevant UK Government Contract reference for non-MOD users.

(v) *Translation services and material availability.*

Freelance translation service is available at varying rates per 1000 words of original language. Translation services available to MOD members only.

(w) *Customer relation and user need services.*

SDI Service, user profile service.

(y) *Staff and training (optional).*

DRIC has a team of subject specialists to analyze and subject index incoming reports and to carry out literature searches on request.

(z) *Comments.*

Additional detailed information concerning DRIC processes can be found in the following material:–

Extracts of:	Page
DRIC Guide to Services	63–65
DRIC Leaflet No.3	66–68
DRIC Leaflet No.10	69–70
DRIC Leaflet No.14	71–73
DRIC/TECHENQ/78/1	74

SEARCHES

Searches of DRIC's own defence-oriented data base are supplemented in appropriate subject areas by searches in the many data bases relating to openly available reports and journal articles available on the European Space Agency's RECON service and the British Library's BLAISE service. DRIC has terminals on-line to these services and searches are conducted in a manner similar to that described above for DOORS.

Data bases available on the RECON system include:

NASA Scientific and Technical Aerospace Reports abstracts (STAR)
International Aerospace Abstracts (IAA)
US Government Reports Announcements (NTIS-GRA)
Physics, Electronics and Electrical Engineering and Control Abstracts (INSPEC)
Chemical Abstracts
Metals Abstracts (METADEX)
Engineering Index (COMPENDEX)
Electronics Components Databank (ELECOMPS)
World Aluminum Abstracts
Environmental Abstracts
BIOSIS
ISMEC
Oceanic Abstracts.

Data bases on the BLAISE system include:

US National Library of Medicine's MEDLINE, TOXLINE and CHEMLINE
MARC Cataloguing information.

Subject Searches should be requested on DRIC/TECHENQ/74/1. In addition to the topic of the search, information which should be given on the Form includes the period to be covered, any limitations on reports to be retrieved (e.g. security gradings, not by certain authors), and one or two references to papers already known to be relevant to the subject. Requesters outside MOD are required to supply a statement of need-to-know.

How can one obtain reports from DRIC?

Reports from DRIC's collection are available to MOD staff and Defence Contractors on loan, or for retention where the number of copies permits. Many reports are available on microfiche which are always sent for retention.

Requests for reports should always be made on Form DRIC REQ 1. Supply of reports to requesters inside MOD is straightforward where the DRIC Reference number is quoted on the form or where enough information about the report is given for this number to be quickly found in DRIC's records. (The DRIC reference number is in the form BR-nnnnn for British reports and P-nnnnnn for overseas reports.) For non-MOD requesters, DRIC may have to seek permission for the release of the report and this may cause some delay; in the case of classified reports, non-MOD requesters should quote their need-to-know and the relevant UK Government defence contract reference.

If requested reports are not already available in DRIC's collection, attempts will be made to obtain them from appropriate sources. In the case of US reports, the US authorities insist on a specific need-to-know for unclassified and classified reports and requesters will be asked to complete a special need-to-know form.

What other services does DRIC offer?

Translating

DRIC has facilities for the translation into English of foreign language scientific and technical papers and reports, including classified ones. A limited amount of translation into a foreign language is also undertaken. These services are available to MOD staff only.

Translating is carried out either by a panel of freelance translators and in this way most languages can be covered. Close liaison is maintained with the MOD General Linguistic Service. Completed translations are added to DRIC's collection and are announced in Defence Research Abstracts. A request to DRIC for a translation should include the

document to be translated, preferably in original form, plus two photocopies. On receipt in DRIC a check will be made with the Aslib Index of Translations to see whether a translation already exists. (If this check has already been carried out this should be stated.)

Translations are subject to copyright and are normally supplied for use within MOD only, but may be issued outside on receipt of a personal-use-only declaration.

Military Specifications

DRIC has a comprehensive and regularly updated library on microfilm of US Military Specifications and associated documents which includes the following series:

MIL Specifications

Federal Specifications quoted in MIL Specifications

MIL Standards

MIL Handbooks

Drawings in AN, MS and NAS series as referenced in MIL documents

Qualified Products Lists (QPLs).

Photocopies from the microfilm are available on loan or can sometimes be provided for retention. A number of US military specifications of key interest to MOD are held in original paper copy form and they are available on loan.

DRIC staff can help to identify relevant specifications using subject and title indexes in cases where the requester cannot quote a reference number.

DRIC also maintains a library of other US specifications and holds a number of Commonwealth and other foreign specifications. Staff of the Specifications Section can assist with locating sources of supply of specifications not held by DRIC.

Requesters may visit DRIC to carry out their own searches, but arrangements to do this must be made in advance.

Requests for specifications should be made on DRIC REQ 1.

Defence Spin-Off

It is official policy that whenever possible, the results of UK defence research and development shall be applied in the civil field. Copies of any MOD reports received by DRIC which can be given an unlimited distribution are passed to the Department of Industry's Technology Reports Centre (TRC) and to the British Library Lending Division both of which provide services to the civil field. In addition, DRIC scans all unclassified and restricted reports to determine whether they contain new ideas or "know-how" which would be of value to British industry. Permission for unlimited distribution is requested for any reports (or selected parts thereof) which meet this requirement and they are passed to TRC which makes the information available via a Tech. Alert service. Tech. Alerts are published in the technical press. (Originators who think that a report might be suitable for a Tech. Alert can assist by quoting this on Form DRIC/BR/75/1 if used, or in a note accompanying the report.)

Publications

DRIC issues a number of leaflets which describe in greater detail the services outlined in this brochure and several other specialised publications as follows:

- DRIC Newsletter.
- Directory of Scientific, Technical and other Specialised Information Services in the Ministry of Defence (available to MOD only).
- Travel Guide to Ministry of Defence Establishments (available to MOD only).
- Overseas Scientific and Technical Liaison Officers in the United Kingdom (available to MOD only).
- DRIC Directory of Corporate Authors.
- Defence Research Abstracts Magnetic Tape Manual – DRIC Manual 1 (DRIC-BR-36051).
- Manual for the Descriptive Cataloguing of Documents – DRIC Manual 2 (DRIC-BR-43828).
- DRIC Manual for Abstracting and Subject Indexing – DRIC Manual 3 (DRIC-BR-44600).
- Manual on Computerised Selective Dissemination of Information Procedures – DRIC Manual 4 (DRIC-BR-46986).
- Guide to Profile Construction of Headings and References used in the DRIC Directory of Corporate Authors – DRIC Manual 6 (DRIC-BR-55016).

- DRIC-SPEC-1000 Format Standards for Scientific and Technical Reports Prepared for the Procurement Executive, Ministry of Defence (DRIC-BR-27012).
- DRIC-SPEC-2000 Format Standards for Ministry of Defence Research and Development Reports (DRIC-BR-52505).
- Leaflet No.1 – DRIC Literature Resources and Services.
- Leaflet No.2 – DRIC On-Line Terminal to ESA Space Documentation Service (SDS).
- Leaflet No.2a – Using RECON Printouts supplied by DRIC.
- Leaflet No.3 – Defence Research Abstracts.
- Leaflet No.4 – US Military Specifications, handbooks, MIL Standards and Federal Specifications.
- Leaflet No.5 – Microfiche.
- Leaflet No.6 – DRIC SDI Services.
- Leaflet No.7 – DRIC On-Line Terminal to the British Library Automated Information Service (BLAISE).
- Leaflet No.8 – DRIC Translation Service.
- Leaflet No.9 – Notes for Translators.
- Leaflet No.10 – Technical Enquiry Service.
- Leaflet No.12 – Explanatory Leaflet for form DRIC/BR/75/1 "Distribution of Reports via DRIC".

PROCUREMENT EXECUTIVE MINISTRY OF DEFENCE

DEFENCE RESEARCH INFORMATION CENTRE

STATION SQUARE HOUSE ST MARY CRAY ORPINGTON KENT BR5 3RE TELEX 896866 TELEPHONE ORPINGTON 32111

DRIC Leaflet No. 3 (Revised March 1978)

DEFENCE RESEARCH ABSTRACTS

Unclassified-controlled and classified scientific and technical reports* received in DRIC from government establishments, firms and other organisations working in the defence field in the UK and overseas countries are announced in DRIC's Defence Research Abstracts (DRA) journal.

This journal is issued in two main editions:

MOD Edition (semi-monthly)	-	this edition is graded Confidential Discreet and is available to MOD staff only.
Contractors Edition (monthly)	-	this edition is graded Restricted and is intended primarily for UK Government defence contractors.

All reports announced are available to MOD requesters in paper copy form on loan or for retention if stock permits. Many reports, including all MOD reports, are available for retention as microfiche (see DRIC Leaflet No. 5 for more information on microfiche). Availability of reports, as paper copies or microfiche, to UK Government defence contractors may be subject to confirmation of a relevant need-to-know or the receipt of other necessary approvals.

INDEXES

Computer-produced subject, author, report number and DRIC accession number indexes are included in each issue of both editions of DRA. Quarterly and annual cumulated indexes are issued as separate publications. These indexes contain subject, author, report number, DRIC accession number, corporate author and monitoring agency, contract number, translations, conference, and titles sections. Each index entry includes the DRIC accession number (for requesting purposes) and a DRA Location Number which facilitates reference to the abstract of the report.

**Unlimited (openly available) MOD reports are also announced in DRA; any other Unlimited reports received are passed to the Department of Industry Technology Reports Centre for announcement in their R&D Abstracts Journal. The latter is available to MOD and UK Government defence contractors free of charge from TRC upon authorisation from DRIC.*

/Contd.

No limitations on distribution or further disclosure

SUBJECT COVERAGE

Defence Research Abstracts covers a wide range of subjects, and entries are arranged under twenty-two subject fields which are subdivided into groups, as follows:-

AERONAUTICS

Aerodynamics
Aeronautics
Aircraft
Aircraft Flight Instrumentation
Air Facilities

AGRICULTURE

(Not subdivided)

ASTRONOMY AND ASTROPHYSICS

(Not subdivided)

ATMOSPHERIC SCIENCES

Atmospheric Physics
Meteorology

BEHAVIOURAL AND SOCIAL SCIENCES

Administration and Management
Documentation and Information Technology
Economics
History, Law, and Political Science
Human Factors Engineering
Humanities
Linguistics
Man-Machine Relations
Personnel Selection, Training, and Evaluation
Psychology (Individual and Group Behaviour)
Sociology

BIOLOGICAL AND MEDICAL SCIENCES

Biochemistry
Bioengineering
Biology
Bionics
Clinical Medicine
Environmental Biology
Escape, Rescue, and Survival
Food
Hygiene and Sanitation
Industrial (Occupational) Medicine
Life Support
Medical and Hospital Equipment and Supplies
Microbiology
Personnel Selection and Maintenance (Medical)
Pharmacology
Physiology
Protective Equipment
Radiobiology
Stress Physiology
Toxicology
Weapon Effects

CHEMISTRY

Chemical Engineering
Inorganic Chemistry
Organic Chemistry
Physical Chemistry
Radio and Radiation Chemistry

EARTH SCIENCES AND OCEANOGRAPHY

Biological Oceanography
Cartography
Dynamic Oceanography
Geochemistry
Geodesy
Geography
Geology and Mineralogy
Hydrology and Limnology
Mining Engineering
Physical Oceanography
Seismology
Snow, Ice, and Permafrost
Soil Mechanics
Terrestrial Magnetism

ELECTRONICS AND ELECTRICAL ENGINEERING

Components
Computers
Electronic and Electrical Engineering
Information Theory
Subsystems
Telemetry

ENERGY CONVERSION (NON-PROPULSIVE)

(Not subdivided)

MATERIALS

Adhesives and Seals
Ceramics, Refractories, and Glasses
Coatings, Colourants, and Finishes
Composite Materials
Fibres and Textiles
Metallurgy and Metallography
Miscellaneous Materials
Oils, Lubricants, and Hydraulic Fluids
Plastics
Rubbers
Solvents, Cleaners, and Abrasives
Wood and Paper Products

MATHEMATICAL SCIENCES

Mathematics and Statistics
Operations Research

MECHANICAL, INDUSTRIAL, CIVIL, AND MARINE ENGINEERING

Air Conditioning, Heating, Lighting, and Ventilating
Civil Engineering
Construction Equipment, Materials, and Supplies
Containers and Packaging
Couplings, Fasteners, and Joints
Ground Transportation Equipment
Hydraulic and Pneumatic Equipment
Industrial Processes
Machinery and Tools
Marine Engineering
Pumps, Filters, Pipes, Tubing, and Valves
Safety Engineering
Structural Engineering

METHODS AND EQUIPMENT

Cost Effectiveness
Laboratories, Test Facilities and Test Equipment
Recording Devices
Reliability
Reprography

MILITARY SCIENCES

Antisubmarine Warfare
Chemical, Biological, and Radiological Warfare
Defence
Intelligence
Logistics
Nuclear Warfare
Operations, Strategy, and Tactics

MISSILE TECHNOLOGY

Missile Launching and Ground Support
Missile Trajectories
Missile Warheads and Fuzes
Missiles

NAVIGATION, COMMUNICATIONS, DETECTION, AND COUNTERMEASURES

Acoustic Detection
Communications
Direction Finding
Electromagnetic and Acoustic Countermeasures
Infrared and Ultraviolet Detection
Magnetic Detection
Navigation and Guidance
Optical Detection
Radar Detection
Seismic Detection

NUCLEAR SCIENCE AND TECHNOLOGY

(Not subdivided)

ORDNANCE

Ammunition, Explosives, and Pyrotechnics
Bombs
Combat Vehicles
Explosions, Ballistics, and Armour
Fire Control and Bombing Systems
Guns
Rockets
Underwater Ordnance

PHYSICS

Acoustics
Crystallography
Electricity and Magnetism
Fluid Mechanics
Masers and Lasers
Optics
Particle Accelerators
Particle Physics
Plasma Physics
Quantum Theory
Solid Mechanics
Solid-State Physics
Thermodynamics
Wave Propagation

PROPULSION AND FUELS

Air-Breathing Engines
Combustion and Ignition
Electric Propulsion
Fuels
Jet and Gas Turbine Engines
Nuclear Propulsion
Reciprocating Engines
Rocket Motors and Engines
Rocket Propellants

SPACE TECHNOLOGY

Astronautics
Spacecraft
Spacecraft Trajectories and Re-entry
Spacecraft Launch Vehicles and Ground Support

DO YOU SEE DEFENCE RESEARCH ABSTRACTS REGULARLY?

If not please ask to see a copy either from your local information officer or librarian, or direct from DRIC using the slip below. A sample copy can be sent if you wish to assess further the value of the journal. If you are a Project Officer responsible for a contract, does your contractor know of the Contractors Edition of DRA?

To: DRIC/Publications
Room 506
Station Square House
St Mary Cray
Orpington
Kent
BR5 3RE

*I do not see Defence Research Abstracts at present; please add my name to the distribution list.

*Please send me a sample copy of:

☐ Defence Research Abstracts MOD Edition

☐ Defence Research Abstracts Contractors Edition

☐ DRA Cumulated Indexes

*delete as applicable.

Signed ..... Date .....

Name
(IN BLOCK LETTERS) .....

Branch or
Establishment .....

.....

.....

PROCUREMENT EXECUTIVE MINISTRY OF DEFENCE

DEFENCE RESEARCH INFORMATION CENTRE

STATION SQUARE HOUSE ST MARY CRAY ORPINGTON KENT BR5 3RE TELEX 896866 TELEPHONE ORPINGTON 32111

DRIC Leaflet No. 10 (Revised March 1978)

DRIC TECHNICAL ENQUIRY SERVICE

THE SERVICE

DRIC has a team of subject specialists who carry out subject searches of the scientific and technical report literature on request for Ministry of Defence Branches and Establishments, and for organisations with current UK Government defence contracts. See Annex A to this leaflet for details of DRIC's team of literature searchers and their subject specialisations.

LITERATURE RESOURCES

In house sources

DRIC's holdings comprise the reports accessioned by Mintech Technology Reports Centre and the Naval Scientific and Technical Information Centre before 1 October 1971, plus all defence controlled and classified reports received in DRIC since that date (total stock is estimated at over 800,000 reports). All are fully indexed. DRIC also has access to the Unlimited reports held by the Department of Industry Technology Reports Centre at St. Mary Cray.

External sources

DRIC has its own RECON (REmote CONsole) terminal through which it is linked on-line to the ESA Space Documentation Service network computer at Frascati, near Rome. The RECON terminal permits rapid and exhaustive searching of a data base comprising over nine million references to open reports and published papers. The major data files available include the NASA Scientific and Technical Aerospace Reports (STAR) bulletins since 1962, the US National Technical Information Service bulletins (Government Report Announcements) since 1970, Chemical Abstracts since 1969 and INSPEC since 1971. This service is described more fully in DRIC Leaflet No. 2.

DRIC also has a dial-up terminal to the British Library Automated Information SErvice (BLAISE). On-line access to BLAISE enables DRIC to search an extensive data base of life sciences literature. Files available include MEDLINE, TOXLINE and CHEMLINE, in addition to MARC (both UK and US versions). The number of literature references on file totals over four million. This service is described more fully in DRIC Leaflet No. 7.

/Contd.

No limitations on distribution or further disclosure

External sources (contd.) DRIC also holds printed indexes to the major US official abstract bulletins and these too are used in answering enquiries.

REQUEST PROCEDURE

Requests for subject searches should be made on form DRIC/TECHENQ/78/1 (copy attached). Requests should be addressed to DRIC Technical Enquiries Section, Room 507, Station Square House, St. Mary Cray, Orpington, Kent, BR5 3RE (Telephone: Orpington 32111, Extension 249).

When requesting a search the following should be specified:

i the subject scope of the enquiry

ii the period to be covered

iii any limitation on the security grading of the reports to be retrieved

iv any other limitations on the reports to be retrieved (eg reports by a particular author or originated by a particular organisation, etc)

v whether details of reports available from DRIC are required, or whether details of reports announced by the US but not currently released to the UK are also required

vi the form in which the results of the search are to be presented. DRIC can provide a list of report references, abstracts of relevant reports and copies of relevant reports; the normal practice is to provide abstracts to enable the requester to decide whether the reports are likely to be of interest, before the full reports are sent.

Provision by the requester of one or two literature references known to be relevant can be of great assistance to DRIC staff when searching for further references.

VISITS TO DRIC

Requesters from the defence community are welcome to visit DRIC for the purpose of identifying and scanning reports. As DRIC's holdings comprise several collections of reports indexed by different methods, advance notice of such visits, together with the details of the proposed search, should be given. This will enable DRIC staff to effect a preliminary search.

PROCUREMENT EXECUTIVE, MINISTRY OF DEFENCE
DEFENCE RESEARCH INFORMATION CENTRE
STATION SQUARE HOUSE ST MARY CRAY ORPINGTON KENT BR5 3RE TELEX 896866 TELEPHONE ORPINGTON 32111

DRIC Leaflet No. 14 (Revised March 1978)

UNCLASSIFIED OR UNLIMITED?

A brief explanation of these terms is given below in an attempt to clarify the distinction.

If a document is not marked RESTRICTED or above, then it is UNCLASSIFIED; there is no lower security classification. Although UNLIMITED is often indicated as a security marking, it is strictly a distribution statement*, and indicates that an UNCLASSIFIED document has been approved for release to the public (in the UK, copies are sent to the Department of Industry Technology Reports Centre (TRC) and the British Library Lending Division. To warrant UNLIMITED distribution the document must conform to certain criteria. For example it must contain no matter which is objectionable on grounds such as policy, commercial security or adverse comment on commercial products. It must be clearly marked as being openly available or with a purchase price. Additionally there are restrictions on the categories of unpublished documents which may be cited as literature references.

To sum up, an UNLIMITED report must be positively identified (and marked) as such or bear a clear indication that it is suitable for public release; all other UNCLASSIFIED reports must be treated as documents with limitations on their distribution.

*Note. In US practice, the distinction is rigorous. The DDC Document Control Form DD1473 has separate sections for "Security Classification" and "Distribution Statement"; the notes on the latter give the standard forms of statement to be used, including "Distribution of this document is unlimited". In the UK the term UNLIMITED is often used on its own, as it necessarily implies UNCLASSIFIED, and this practice is followed on the Document Control Sheet contained in DRIC Spec 1000, and the Report Documentation Page in DRIC Spec 2000.

WHERE TO APPLY: DRIC OR TRC

Reports that are known to be UNLIMITED should be requested from TRC, unless they are also known to have P or BR accession numbers in which case they should be requested from DRIC. All other reports should be requested from DRIC, including AGARD publications for which DRIC is the national distribution centre. The correct request form should be used, ie DRIC REQ 1 for DRIC held items and TRC/72/2 for TRC held items.

The attached Report Location Flowchart has been drawn up to give guidance as to where to apply for various categories of reports. It also serves as an aid in deciding whether a report is likely to be UNLIMITED or not. Notes on the flow-chart are given overleaf.

/Contd.

No limitations on distribution or further disclosure

NOTES

1. The flowchart is not intended to cover all possibilities; the following points are made for your guidance.

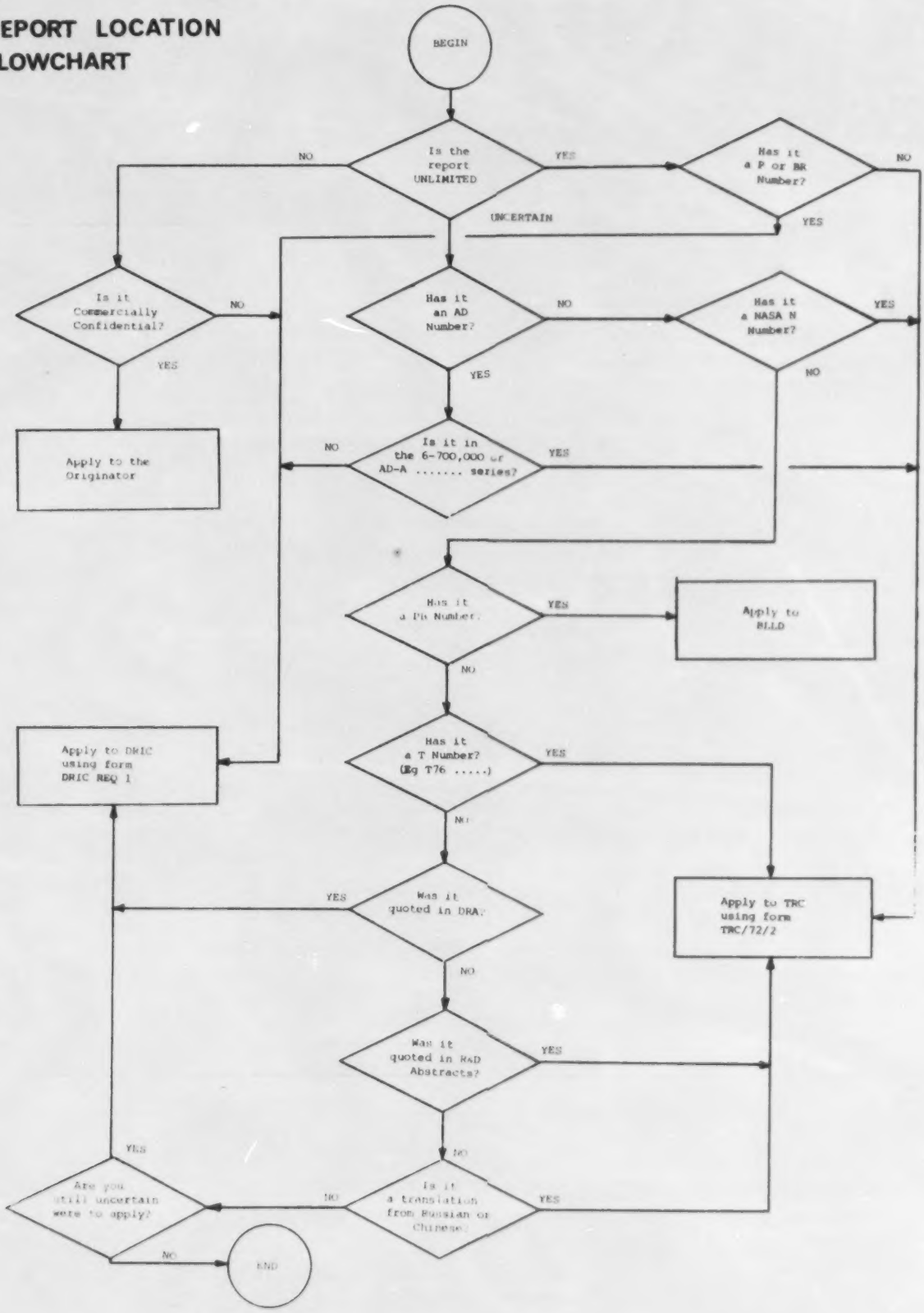
2. 'Commercially confidential' reports are exemplified by Research Association reports, usually graded 'Confidential to Members'.

3. 'DRA' should be taken to mean Defence Research Abstracts (Jan. 1972 onwards) or Part 2 of R & D Abstracts (up to Dec. 1971).

4. 'R & D Abstracts' should be taken to mean R & D Abstracts (Jan. 1972 onwards) or Part 1 of R & D Abstracts (up to Dec. 1971).

5. You should not reach the point 'END'. If you do then you have not followed the flowchart correctly - start again from 'BEGIN'.

REPORT LOCATION FLOWCHART



DEFENCE RESEARCH INFORMATION CENTRE

REQUEST FOR LITERATURE SEARCH

This form may be used by MOD staff, and by members of the civilian community when requesting literature searches in support of UK Government defence contracts and projects.

For DRIC use
Date received:
.....
Search reference:
.....

REQUESTOR Name: Telephone No. Ext.
Address:

SUBJECT Please state the subject as specifically as possible:

ADDITIONAL INFORMATION Give any technical background or other information thought necessary to clarify your enquiry *(continue overleaf if necessary)*:

REFERENCES Please list authors, corporate sources or accession numbers of any relevant references already known to you:

LIMITATIONS ON SEARCH

1. Grading of literature references *(Please tick as appropriate)*
   - Unlimited (open) (RECON/BLAISE searches) ☐
   - Defence controlled and classified ☐
2. Period to be covered
   From .....
   To .....
3. Size
   Maximum number of references required
   .....
   If fewer than ..... please broaden search or search back files as appropriate

NEED-TO-KNOW *This section must be completed by all requestors from outside the Ministry of Defence*

UK Government defence contract number or details of any relevant UK Government defence project.....
.....

Name, address and telephone number of sponsoring MOD Project Officer:

Signed: Date:

When completed this form should be sent to: Defence Research Information Centre, Technical Enquiries Section, Room 507, Station Square House, St Mary Cray, Orpington, Kent, BR5 3RE. Telephone: Orpington 32111, Ext. 249.

DRIC/TECHENQ/78/1 (Superseding DRIC/TECHENQ/74/1)

JH

APPENDIX A-6

Defence Scientific Information Service (DSIS)
National Defence Headquarters (NDHQ)
101 Colonel By Drive
Ottawa, Canada K1AOK2

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
DSIS as an agency of NDHQ/CRAD (Chief Research and Development) acts as the central organization for:
(a) Recording the existence of scientific and technical documents dealing with Department of National Defence (DND) R&D and distributing these documents within DND and to allied countries.
(b) Acquiring, cataloging, storing, announces, retrieves and disseminates Canadian and foreign defence-related RDT&E reports and project information.

(b) *Sources of data and material distributed.*
Sources of information are Canadian, NATO, and Commonwealth defence departments and miscellaneous.

(c) *Size of collection(s).*
500,000 paper reports and 200,000 microfiche.

(d) *Listing of data banks – include description.*
Bibliographic data.
Work Unit Data (projects).
Staff Studies (military position papers, etc.).
Low-Intensity Conflict Information Analysis (terminated).

(e) *How is material accessioned and retrieved?*
Cataloguing data is entered on in-house computer, announced by selective dissemination of information and document digests, and retrieved by remote terminal retrospective searching on outside computer.

(f) *National policies affecting dissemination.*
Government to government distribution only.

(g) *Initial distribution policy and methods.*
Initial distribution is by pre-clearance and semi-automatic distribution to defence departments of allied countries. A digest of Canadian reports is also distributed.

(h) *Secondary distribution policy and methods.*
Secondary distribution is through defence departments after clearance (if not covered by pre-clearance).

(i) *Restrictions on dissemination.*
Security and content clearances as well as exchange considerations.

(j) *Who can access the information?*
Canadian access is limited to defence department and its contractors. No foreign access except for requests for specific reports.

(k) *Method of domestic access.*
Remote terminal retrospective searching on outside computer. Letter and telephone requests.

(l) *Method of foreign access if permitted.*
Requests for specific reports as announced in digest of Canadian documents.

(m) *User registration method if required.*
Domestic users registered in a Patron File. Contactors must make special application for access.

(n) *Announcement media.*
Restricted and Secret Document Digests.
Confidential Canadian Digest.
Selective Dissemination of Information (SDI).

(o) *Is material sold or loaned or both?*
Paper copies are distributed or loaned. Microfiche copies are distributed.

(p) *Cost and method of payment for material and services.*
No costs applied to users except for remote-terminal search time.

(r) *Promotional material available.*
Brochure on DSIS services (in preparation).
Guide to DSIS services.
Guide to SDI services from DSIS.

(s) *What aspects of your operation are automated?*
Patron File, Master records, SDI, retrieval, microfilm indexes, Document Digest printing.

(t) *Guidelines for access to sensitive material.*
Patron File (list of users) contains need-to-know and clearance data.

(u) *Conditions for release of material.*
All limited-distribution and classified documents are released for defence purposes only. Further restrictions may be applied as appropriate.

(v) *Translation services and material availability.*
DSIS has no in-house translation service but arranges translation of research and development reports as required.

(w) *Customer relation and user need services.*
Customer Services Centre established as initial and routine contact point to DSIS. Liaison visits regularly to heaviest users. Routine yearly contact with SDI clients to confirm profiles if not already adjusted.

(x) *Future plans and developments.*
It is intended to bring the retrospective searching in-house.

(y) *Staff and training (optional).*
Staff 35 total, 8 professionals of which 6 are scientists, 1 is a librarian, and 1 is a computer specialist.
Support staff training is on-the-job.

APPENDIX A-7

Defense Technical Information Center (DTIC)
Cameron Station
Alexandria, Va. 22314, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
DTIC is the clearing house for the US Department of Defence (DoD). Collections of research and development in virtually all fields of Science and Technology. A primary field activity of the Defense Supply Agency, DTIC has the mission of answering three questions in support of DoD Research, Development and Test, namely: (1) What research is planned?, (2) What research is currently being performed?, and, (3) What results were realized by completed research?.

(b) *Sources of data and material distributed.*
Defense agencies and associated contractors are required to deposit information (both unclassified and classified including secret and restricted data) into various data banks. DD form 1473 must accompany all inputs.

(c) *Size of collection(s).*
Technical Report Data Base contains over 1.2 million titles categorized into two-level arrangement consisting of 22 major subject fields and further divides into 188 related subject groups. (See "s".)

(d) *Listing of data banks – include description.*
Master and inverted files for Technical Report Bibliographic data, Research and Technology Work Unit resumés, Program Planning summaries, Independent Research and Development resumés, central registry.

(e) *How is material accessioned and retrieved?* (See attachment.)
Documents are screened to insure they are of S&T Scope and are not duplicates. Upon selection, each report is assigned an AD (Accession Document) number, processed into the collection and recorded by micro-photography.

(f) *National policies affecting dissemination.*
Security and Sensitivity of material. DTIC serves the general public by releasing material to NTIS, identifying and advising report availability and seeking public release of documents.

(g) *Initial distribution policy and methods.*
Automatic Document Distribution program (ADD).
Microfiche.
Automatic Magnetic Tape Distribution program (AMTD).
Scheduled Bibliography.

(h) *Secondary distribution policy and methods.*
Report Demand Bibliography.
Direct Reponse Bibliography.

(i) *Restrictions on dissemination.* (See attachment.)
Classification and limitation markings, user registration.

(j) *Who can access the information?*
Registered users consisting of US Government R&D activities, associated contractors, sub-contractors, and grantees and organizations between contracts through a potential contractor program. There are collections, however, that contain proprietary data or information compiled for specific purpose of DoD management decisions which are available to defense components only.

(k) *Method of domestic access.* (See attachment.)
Classified/Limited Services – Direct DTIC Contact, use DTIC form 1.
Unclassified/Limited Documents – NTIS Contact.

(l) *Method of foreign access if permitted.*
Unclassified/Unlimited – Normal contact is through NTIS.
Other contact is through embassy or other country designated contact media.

(m) *User registration method if required.* (See attachment.)
Completion of DD form 1540. Classified Services also require a DD form 1541 "Facility Clearance Register". Process described in a manual entitled: Registration for S&T Information services of DoD (DSAM 4185.3).

(n) *Announcement media.*
Technical Abstract Bulletin (TAB) and Indexes, Annual Indexes, TAB Quarterly Indexes, Bibliography of Bibliographies and DDC Digest. Also, brochures, pamphlets, manuals and journal articles.

(o) *Is material sold or loaned or both?*
Some sold, some free.

(p) *Cost and method of payment for material and services.*
Payments are handled by NTIS and vary with particular service. Technical reports have a $3.00 service charge for full-sized copy or $.95 for microfilm. This cost also applicable to unclassified/unlimited DoD documents of NTIS if you are a DTIC registered user and have an NTIS deposit account. (See NTIS.)

(q) *Request and registration forms (samples).*
See attached.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?* (Also see "z".)
Defense RDT&E On-Line System – a network of remote terminals linked to DTIC's Central Computer, accessing all four data banks. Consisting of: 900,000 technical records, 116,000 one-page records for work Unit Information, 27,000 or more one-page summaries of completed or active products, 19,000 one-page summaries of IR&D. A typical terminal installation consists of an input/output CRT display and printer. A magnetic-tape cassette is also available for use with the system. Special terminal facilities are made available for DDC users in Los Angeles, Washington D.C. and Boston. User manual is DSAM 4185.13.

(t) *Guidelines for access to sensitive material.*
Clearance request form used to gain approval of release from office invoking the restriction. (See attached.)

(u) *Conditions for release of material.*
Must uphold conditions of classification and sensitivity.

(w) *Customer relation and user need services.*
DoD components are offered all four data banks. Other users have access to TR's and WUIS. DTIC also offers referal to S&T information services not available at DDC.

(x) *Future plans and developments.*
DTIC has a continuing program to study techniques and equipment to improve information transfer.

(z) *Comments.*
Data Bank By-Products:

1. Announcement publications.
2. Automated document distribution.
3. Automatic magnetic-tape distribution program.
4. Bibliography program.
5. Defense R&D of the 1960's.
6. Defense R&D of the 1970's.
7. Selective dissemination of information.
8. Technical vocabulary.
9. Recurring management information system reports.

Additional detailed information concerning DTIC is as follows:–

(Note – all references to DDC are now DTIC.)

Extract DDC:	Page
Users Guide	79–80
DD form 1541	81
DD form 1540	82–83
DD form 1473	84–85
DD form 55	86–87

WHAT ARE THE REGISTRATION PROCEDURES?

Registering an organization for DTIC services involves the following actions by the requesting organization and by DTIC:

1. *Requester* – Complete a DD Form 1540, Registration for Scientific and Technical Information Services (see DSA Manual 4185.3 for registration instructions) and distribute according to the Copy Designation shown on the form. Contractors who require classified services are required to complete a DD Form 1541, Facility Clearance Register, and forward to the appropriate DCASR.

2. *DTIC* – Upon receipt of a completed and certified DD Form 1540, assign a DoD User Code Number and process the form through the computer operations for inclusion on the central registry. Return a duplicate copy of the DD Form 1540 to the sender with a service packet of materials, including applicable request forms (except for the DTIC Forms 1, Document Requests, which are forwarded if the user elects to open an NTIS deposit account).

3. *Requester* – If copies of technical reports are desired, two options are available to registered DTIC users: (1) order directly from the National Technical Information Service (NTIS) with check, purchase order, money order, or American Express Credit Card Number to cover service charges, or (2) order directly from DTIC or NTIS after establishment of an NTIS Deposit Account. DTIC users are encouraged to open an NTIS Deposit Account because faster response to requests and a $.60 discount is provided for DTIC-supplied documents sent directly to DTIC by option (2) above. An NTIS deposit account application form and instructions are contained in the DTIC service packet provided each new DTIC user upon registration.

4. *DTIC* – If the user established an NTIS Deposit Account, a supply of DTIC Forms 1, Document Request, is prepunched with the applicable DoD User Code Number and forwarded to the registered user organization.

5. *Requester* – If certified to receive classified services, complete the DTIC Form 9 (in the DTIC service packet) to receive copies of the Technical Abstract Bulletin and corresponding Indexes free of charge, and forward to DTIC. (All organizations, except US Government agencies, are required to complete DD Form 1541, Facility Clearance Register, to receive classified services from DTIC.)

6. *DTIC* – Place the names of registered organizations on the distribution list to receive DTIC Digest copies on an automatic basis.

HOW ARE INCOMING REPORTS CONTROLLED?

Accessions Program

The acquisition, evaluation, and selection of technical reports applicable to the RDT&E program. This program is designed to maintain high standards for accepting reports into the DTIC collection, while providing for maximum interchange of information.

Reports are received from Government installations, industrial contractors, universities, and non-profit organizations participating in the RDT&E program. These reports are generated by several funding methods such as DoD sponsored, DoD co-sponsored with non-DoD organizations, and non-DoD sponsored. The sources and types of funding are important factors in the selection decision.

The DTIC collection consists mainly of reports submitted at the time of primary distribution. The incidence of acceptance to the collection is high since the preparation and selection are controlled by identical or compatible DoD regulations. Each report is examined and added to the collection if it contributes to one or more aspects of the program. A report is rejected if its technical coverage is considered insignificant.

Reprints of reports published in journals are checked for duplication with information received previously through the primary distribution procedures.

Special arrangements are made for acquisition of reports not financed by DoD and not controlled by DoD regulations or contractual agreements, but which meet report selection requirements and represent technically significant additions to the DTIC collection.

Also, if references are made to valuable technical reports in bibliographies or other publications received in DTIC, or if requests are received for reports which are not included in the current collection, DTIC makes every effort to acquire copies of those reports.

HOW DO YOU SUBMIT DOCUMENTS TO DTIC?

1. Prepare the technical report in accordance with MIL-STD 847A.

2. Double check the report to determine whether a DD Form 1473, Report Documentation Page, has been included. Completion of this one-page summary is vital to activities within DTIC for processing, announcing, and linking collections. For example, completion of Block 10 of the DD Form 1473, Program Element, Project, Task Area and Work Unit Numbers, enables cross-referencing the ongoing research projects reported on the Work Unit Information Summary, to the completed research efforts included in the technical reports.

3. Reconsider the report cover if it is a dark color. Dark colors create problems in microphotography. It is difficult to get good legibility of downgrading and declassifying markings when they have been printed on these colored covers. For instance, black ink on a dark blue cover does not provide enough contrast to discern the printing, either on microform or blowback copy. If dark colors are used, you are urged to repeat downgrading and declassifying statements on the first page following the cover.

4. Complete a DTIC Form 50 (DTIC Accessions Notice) and forward with your report, if you wish to be apprised of the AD number assigned to your report. The DTIC Form 50 will be returned with the assigned AD number.

5. Check the number of copies necessary for DTIC:

   (a) 12 copies of unclassified/unlimited reports.

   (b) 2 copies of classified and/or unclassified/limited reports.

   Note: If required number of copies cannot be supplied, DTIC will accept one complete, legible copy on loan, to be returned to you after reproduction.

6. Package the reports and forward by postal services listed below:

   (a) Registered mail for Secret reports.

   (b) Certified or registered mail for Confidential reports.

HOW DO YOU ORDER A DOCUMENT?

Distribution of all documents under the control of DTIC must be made in accordance with the document security level and assigned distribution limitations of the reports. The following paragraphs outline the requirements for requesting various categories of reports.

Classified Documents

To request classified documents which have no additional distribution controls, it is necessary to be a registered DTIC user and certified to receive classified information. Users with NTIS Deposit Accounts order directly from DTIC using a DTIC Form 1. Other requesters order from NTIS citing the document requested, their user code number and the contract registered with DTIC for classified services.

Limited Documents

Documents with distribution limitations are recognizable by the "L" suffix to the AD number. Their limitations are imposed on some classified and most unclassified documents supplied by DTIC. DTIC users affected by the assigned distribution limitation (e.g., contractors or grantees requesting a "US Government Only" report) request on a DTIC Form 55 provided in the DTIC service packet. All DTIC Forms 55 are sent directly to DTIC where the request is validated and forwarded to the document controlling office for release determination.

Unclassified/Unlimited Documents

These documents are not supplied by DTIC but may be ordered from DTIC by users with established NTIS Deposit Accounts. Users may submit requests directly to NTIS, 5285 Port Royal Road, Springfield, Virginia 22161, USA, but DTIC-registered users receive a $.60 discount on Defense documents ordered directly from DTIC. Service charges for these documents are determined by NTIS and are based on number of pages within a document.

FACILITY CLEARANCE REGISTER

INSTRUCTIONS

FOR CONTRACTOR:

1. Complete Part I in duplicate *(three copies if you desire a file copy).*
2. Forward two copies to the Defense Contract Administration Services Region *(DCASR)* having security cognizance over your company.
3. Separate facility clearance registers are required for each location to which classified material will be sent.

FOR COGNIZANT DCASR:

1. Complete Part II.
2. Forward one copy to DDC at the address given below.
3. If you have no record of facility clearance, return forms to contractor with appropriate explanation.

PART I

1. NAME AND MAILING ADDRESS OF FACILITY *(Classified material will be forwarded to this address)*	2. STREET ADDRESS *(Actual location if different from Item 1)*	
3. TYPED NAME AND TITLE OF REQUESTER	4. SIGNATURE	5. DATE

PART II

6. THE FACILITY LISTED IN PART I IS CLEARED TO RECEIVE AND STORE DEPARTMENT OF DEFENSE CLASSIFIED MATERIAL UP TO AND INCLUDING

☐ SECRET ☐ CONFIDENTIAL

(Any change affecting this facility clearance will be reported immediately to DDC.)

7. NAME AND ADDRESS OF THE DCASR	8. TYPED NAME AND TITLE OF CERTIFYING OFFICIAL	
	9. SIGNATURE	10. DATE

11. MAIL TO: Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

REMARKS

DD FORM 1 SEP 65 1541 REPLACES DDC FORM 62 WHICH IS OBSOLETE EFFECTIVE 1 JAN 1966

REGISTRATION FOR SCIENTIFIC AND TECHNICAL INFORMATION SERVICES

(No carbon paper is required in the completion of this form)

FOR DDC CENTRAL FILE USE

DOD USER CODE

CONTRACT TYPE

USER TYPE

FACILITY CLEARANCE

CONTRACT CLEARANCE

APPROVING OFFICIAL FORWARD COMPLETED FORM TO:

DEFENSE DOCUMENTATION CENTER
ATTN: DDC-TSR-1
CAMERON STATION, BLDG. 5
ALEXANDRIA, VIRGINIA 22314

PART I - REQUESTER APPLICATION

1. ORGANIZATION NAME

2. MAILING ADDRESS *(Street, City, State, ZIP Code)*

3. ATTENTION LINE *(Name and Organizational Title of Requesting Official)*

4. TELEPHONE NUMBER *(Include Area Code)*

5. SIGNATURE

6. DATE

7. PRIME CONTRACT/GRANT OR PROGRAM NO. *(Enter one only)*

8. EXPIRATION DATE OF ITEM 7

9. CLASSIFICATION REQUIRED

☐ UNCLASSIFIED ☐ NATO CLASSIFIED
☐ CONFIDENTIAL ☐ RESTRICTED DATA
☐ SECRET ☐ CNWDI

PART II - PRIME CONTRACTOR APPROVAL *(If Part I is a Subcontractor)*

10. ORGANIZATION NAME AND ADDRESS

11. SUB-CONTRACT NUMBER

12. EXPIRATION DATE OF ITEM 11

13. TYPED NAME AND SIGNATURE

14. DATE

PART III - CERTIFICATION AND APPROVAL

15. ORGANIZATION NAME AND ADDRESS

16. TELEPHONE NUMBER *(Include Area Code)*

17. DATE

18. TYPED NAME AND TITLE OF APPROVING OFFICIAL

19. SIGNATURE

THE DDC CENTRAL FILES MUST BE NOTIFIED IMMEDIATELY OF ANY CHANGES TO INFORMATION PROVIDED ON THIS FORM

(FOR DDC USE ONLY)

PART IV - SUBJECT FIELDS OF INTEREST

Circle required codes below. Mandatory only for Classified Services. First Number is the Subject Field; the second is the more specific group. See Subject Fields on Reverse.

01-01	06-12	11-01	15-05	19-04
01-02	06-13	11-02	15-06	19-05
01-03	06-14	11-03	15-07	19-06
01-04	06-15	11-04	16-01	19-07
01-05	06-16	11-05	16-02	19-08
02-01	06-17	11-06	16-03	20-01
02-02	06-18	11-07	16-04	20-02
02-03	06-19	11-08	16-04.1	20-03
02-04	06-20	11-09	16-04.2	20-04
02-05	06-21	11-10	16-04.3	20-05
02-06	07-01	11-11	17-01	20-06
03-01	07-02	11-12	17-02	20-07
03-02	07-03	12-01	17-02.1	20-08
03-03	07-04	12-02	17-03	20-09
04-01	07-05	13-01	17-04	20-10
04-02	08-01	13-02	17-05	20-11
05-01	08-02	13-03	17-06	20-12
05-02	08-03	13-04	17-07	20-13
05-03	08-04	13-05	17-08	20-14
05-04	08-05	13-06	17-09	21-01
05-05	08-06	13-07	17-10	21-02
05-06	08-07	13-08	18-01	21-03
05-07	08-08	13-09	18-02	21-04
05-08	08-09	13-10	18-03	21-05
05-09	08-10	13-10.1	18-04	21-06
05-10	08-11	13-11	18-05	21-07
05-11	08-12	13-12	18-06	21-08
06-01	08-13	13-13	18-07	21-08.1
06-02	08-14	14-01	18-08	21-08.2
06-03	09-01	14-02	18-09	21.09
06-04	09-02	14-03	18-10	21-09.1
06-05	09-03	14-04	18-11	21-09.2
06-06	09-04	14-05	18-12	22-01
06-07	09-05	15-01	18-13	22-02
06-08	09-06	15-02	18-14	22-03
06-09	10-01	15-03	19-01	22-04
06-10	10-02	15-03.1	19-02	
06-11	10-03	15-04	19-03	

DD FORM 1 JUL 71 1540

REPLACES EDITION OF 1 NOV 68, WHICH MAY BE USED UNTIL EXHAUSTED

COPY DESIGNATION: White - DDC; Green - DDC; Yellow - Approving Official; Pink - Prime Contractor or DDR&E; Gold - Originator

SUBJECT FIELD AND GROUP STRUCTURE

01 Aeronautics

- 01 Aerodynamics
- 02 Aeronautics
- 03 Aircraft
- 04 Aircraft flight instrumentation
- 05 Air facilities

02 Agriculture

- 01 Agricultural chemistry
- 02 Agricultural economics
- 03 Agricultural engineering
- 04 Agronomy and horticulture
- 05 Animal husbandry
- 06 Forestry

03 Astronomy and Astrophysics

- 01 Astronomy
- 02 Astrophysics
- 03 Celestial mechanics

04 Atmospheric Sciences

- 01 Atmospheric physics
- 02 Meteorology

05 Behavioral and Social Sciences

- 01 Administration and management
- 02 Documentation and information technology
- 03 Economics
- 04 History, law and political science
- 05 Human factors engineering
- 06 Humanities
- 07 Linguistics
- 08 Man-machine relations
- 09 Personnel selection, training and evaluation
- 10 Psychology *(Individual and group behavior)*
- 11 Sociology

06 Biological and Medical Sciences

- 01 Biochemistry
- 02 Bioengineering
- 03 Biology
- 04 Bionics
- 05 Clinical medicine
- 06 Environmental biology
- 07 Escape, rescue and survival
- 08 Food
- 09 Hygiene and sanitation
- 10 Industrial *(Occupational)* medicine
- 11 Life support
- 12 Medical and hospital equipment and supplies
- 13 Microbiology
- 14 Personnel selection and maintenance *(Medical)*
- 15 Pharmacology
- 16 Physiology
- 17 Protective equipment
- 18 Radiobiology
- 19 Stress physiology
- 20 Toxicology
- 21 Weapon effects

07 Chemistry

- 01 Chemical engineering
- 02 Inorganic chemistry
- 03 Organic chemistry
- 04 Physical chemistry
- 05 Radio and radiation chemistry

08 Earth Sciences and Oceanography

- 01 Biological oceanography
- 02 Cartography
- 03 Dynamic oceanography
- 04 Geochemistry
- 05 Geodesy
- 06 Geography
- 07 Geology and mineralogy
- 08 Hydrology and limnology
- 09 Mining engineering
- 10 Physical oceanography
- 11 Seismology
- 12 Snow, ice and permafrost
- 13 Soil mechanics
- 14 Terrestrial magnetism

09 Electronics and Electrical Engineering

- 01 Components
- 02 Computers
- 03 Electronic and electrical engineering
- 04 Information theory
- 05 Subsystems
- 06 Telemetry

10 Energy Conversion *(Non-propulsive)*

- 01 Conversion techniques
- 02 Power sources
- 03 Energy storage

11 Materials

- 01 Adhesives and seals
- 02 Ceramics, refractories and glasses
- 03 Coatings, colorants and finishes
- 04 Composite materials
- 05 Fibers and textiles
- 06 Metallurgy and metallography
- 07 Miscellaneous materials
- 08 Oils, lubricants, and hydraulic fluids
- 09 Plastics
- 10 Rubbers
- 11 Solvents, cleaners and abrasives
- 12 Wood and paper products

12 Mathematical Sciences

- 01 Mathematics and statistics
- 02 Operations research

13 Mechanical, Industrial, Civil and Marine Engineering

- 01 Air conditioning, heating, lighting and ventilating
- 02 Civil engineering
- 03 Construction equipment, materials and supplies
- 04 Containers and packaging
- 05 Couplings, fasteners and joints
- 06 Ground transportation equipment
- 07 Hydraulic and pneumatic equipment
- 08 Industrial processes
- 09 Machinery and tools
- 10 Marine engineering
- 10.1 Submarine engineering
- 11 Pumps, filters, pipes, tubing and valves
- 12 Safety engineering
- 13 Structural engineering

14 Methods and Equipment

- 01 Cost effectiveness
- 02 Laboratories, test facilities, and test equipment
- 03 Recording devices
- 04 Reliability
- 05 Reprography

15 Military Sciences

- 01 Antisubmarine warfare
- 02 Chemical, biological, and radiological warfare
- 03 Defense
- 03.1 Antimissile defense
- 04 Intelligence
- 05 Logistics
- 06 Nuclear warfare
- 07 Operations, strategy, and tactics

16 Missile Technology

- 01 Missile launching and ground support
- 02 Missile trajectories
- 03 Missile warheads and fuzes
- 04 Missiles
- 04.1 Air and space launched missiles
- 04.2 Surface launched missiles
- 04.3 Underwater launched missiles

17 Navigation, Communications, Detection and Countermeasures

- 01 Acoustic detection
- 02 Communications
- 02.1 Radio communications
- 03 Direction finding
- 04 Electromagnetic and acoustic countermeasures
- 05 Infrared and ultraviolet detection
- 06 Magnetic detection
- 07 Navigation and guidance
- 08 Optical detection
- 09 Radar detection
- 10 Seismic detection

18 Nuclear Science and Technology

- 01 Fusion devices *(Thermonuclear)*
- 02 Isotopes
- 03 Nuclear explosions
- 04 Nuclear instrumentation
- 05 Nuclear power plants
- 06 Radiation shielding and protection
- 07 Radioactive wastes and fission products
- 08 Radioactivity
- 09 Reactor engineering and operation
- 10 Reactor materials
- 11 Reactor physics
- 12 Reactors *(Power)*
- 13 Reactors *(Non-power)*
- 14 SNAP technology

19 Ordnance

- 01 Ammunition, explosives and pyrotechnics
- 02 Bombs
- 03 Combat vehicles
- 04 Explosions, ballistics and armor
- 05 Fire control and bombing systems
- 06 Guns
- 07 Rockets
- 08 Underwater ordnance

20 Physics

- 01 Acoustics
- 02 Crystallography
- 03 Electricity and magnetism
- 04 Fluid mechanics
- 05 Masers and lasers
- 06 Optics
- 07 Particle accelerators
- 08 Particle physics
- 09 Plasma physics
- 10 Quantum theory
- 11 Solid mechanics
- 12 Solid state physics
- 13 Thermodynamics
- 14 Wave propagation

21 Propulsion and Fuels

- 01 Air breathing engines
- 02 Combustion and ignition
- 03 Electric propulsion
- 04 Fuels
- 05 Jet and gas turbine engines
- 06 Nuclear propulsion
- 07 Reciprocating engines
- 08 Rocket motors and engines
- 08.1 Liquid rocket motors
- 08.2 Solid rocket motors
- 09 Rocket propellants
- 09.1 Liquid rocket propellants
- 09.2 Solid rocket propellants

22 Space Technology

- 01 Astronautics
- 02 Spacecraft
- 03 Spacecraft trajectories and reentry
- 04 Spacecraft launch vehicles and ground support

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)*		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)*		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)*
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT *(of this Report)*		
17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*		
20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*		

DD FORM 1 JAN 73 1473

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

RESPONSIBILITY. The controlling DoD office will be responsible for completion of the Report Documentation Page, DD Form 1473, in all technical reports prepared by or for DoD organizations.

CLASSIFICATION. Since this Report Documentation Page, DD Form 1473, is used in preparing announcements, bibliographies, and data banks, it should be unclassified if possible. If a classification is required, identify the classified items on the page by the appropriate symbol.

COMPLETION GUIDE

General. Make Blocks 1, 4, 5, 6, 7, 11, 13, 15, and 16 agree with the corresponding information on the report cover. Leave Blocks 2 and 3 blank.

Block 1. Report Number. Enter the unique alphanumeric report number shown on the cover.

Block 2. Government Accession No. Leave Blank. This space is for use by the Defense Documentation Center.

Block 3. Recipient's Catalog Number. Leave blank. This space is for the use of the report recipient to assist in future retrieval of the document.

Block 4. Title and Subtitle. Enter the title in all capital letters exactly as it appears on the publication. Titles should be unclassified whenever possible. Write out the English equivalent for Greek letters and mathematical symbols in the title *(see "Abstracting Scientific and Technical Reports of Defense-sponsored RDT/E," AD-667 000)*. If the report has a subtitle, this subtitle should follow the main title, be separated by a comma or semicolon if appropriate, and be initially capitalized. If a publication has a title in a foreign language, translate the title into English and follow the English translation with the title in the original language. Make every effort to simplify the title before publication.

Block 5. Type of Report and Period Covered. Indicate here whether report is interim, final, etc., and, if applicable, inclusive dates of period covered, such as the life of a contract covered in a final contractor report.

Block 6. Performing Organization Report Number. Only numbers other than the official report number shown in Block 1, such as series numbers for in-house reports or a contractor/grantee number assigned by him, will be placed in this space. If no such numbers are used, leave this space blank.

Block 7. Author(s). Include corresponding information from the report cover. Give the name(s) of the author(s) in conventional order *(for example, John R. Doe or, if author prefers, J. Robert Doe)*. In addition, list the affiliation of an author if it differs from that of the performing organization.

Block 8. Contract or Grant Number(s). For a contractor or grantee report, enter the complete contract or grant number(s) under which the work reported was accomplished. Leave blank in in-house reports.

Block 9. Performing Organization Name and Address. For in-house reports enter the name and address, including office symbol, of the performing activity. For contractor or grantee reports enter the name and address of the contractor or grantee who prepared the report and identify the appropriate corporate division, school, laboratory, etc., of the author. List city, state, and ZIP Code.

Block 10. Program Element, Project, Task Area, and Work Unit Numbers. Enter here the number code from the applicable Department of Defense form, such as the DD Form 1498, "Research and Technology Work Unit Summary" or the DD Form 1634, "Research and Development Planning Summary," which identifies the program element, project, task area, and work unit or equivalent under which the work was authorized.

Block 11. Controlling Office Name and Address. Enter the full, official name and address, including office symbol, of the controlling office. *(Equates to funding/sponsoring agency. For definition see DoD Directive 5200.20, "Distribution Statements on Technical Documents.")*

Block 12. Report Date. Enter here the day, month, and year or month and year as shown on the cover.

Block 13. Number of Pages. Enter the total number of pages.

Block 14. Monitoring Agency Name and Address *(if different from Controlling Office)*. For use when the controlling or funding office does not directly administer a project, contract, or grant, but delegates the administrative responsibility to another organization.

Blocks 15 & 15a. Security Classification of the Report: Declassification/Downgrading Schedule of the Report. Enter in 15 the highest classification of the report. If appropriate, enter in 15a the declassification/downgrading schedule of the report, using the abbreviations for declassification/downgrading schedules listed in paragraph 4-207 of DoD 5200.1-R.

Block 16. Distribution Statement of the Report. Insert here the applicable distribution statement of the report from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 17. Distribution Statement *(of the abstract entered in Block 20, if different from the distribution statement of the report)*. Insert here the applicable distribution statement of the abstract from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 18. Supplementary Notes. Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of *(or by)* . . . Presented at conference of . . . To be published in . . .

Block 19. Key Words. Select terms or short phrases that identify the principal subjects covered in the report, and are sufficiently specific and precise to be used as index entries for cataloging, conforming to standard terminology. The DoD "Thesaurus of Engineering and Scientific Terms" *(TEST)*, AD-672 000, can be helpful.

Block 20. Abstract. The abstract should be a brief *(not to exceed 200 words)* factual summary of the most significant information contained in the report. If possible, the abstract of a classified report should be unclassified and the abstract to an unclassified report should consist of publicly-releasable information. If the report contains a significant bibliography or literature survey, mention it here. For information on preparing abstracts see "Abstracting Scientific and Technical Reports of Defense-Sponsored RDT&E," AD-667 000.

REQUEST FOR LIMITED DOCUMENT

NOTE: This form may be classified if necessary. See instructions on reverse. No carbon paper required in the completion of this form.

DDC CONTROL NO.

USER CONTROL NO.

I. REQUEST AND JUSTIFICATION

AD NUMBER

DATE REQUESTED

CLASSIFICATION:
- ☐ Unclassified
- ☐ Confidential
- ☐ Secret
- ☐ RD
- ☐ CNWDI
- ☐ NATO

DISTRIBUTION STATEMENT:
- ☐ U. S. Gov't. Only
- ☐ DoD Only
- ☐ All Release Controlled

} Others to: *(Address in Section III)*

BIBLIOGRAPHICAL INFORMATION *(Include All Available Identifying Data)*

SPONSORING MILITARY ACTIVITY AND SERIES NUMBER

ORIGINATOR'S SERIES NUMBER AND DATE PUBLISHED

CONTRACT OR GRANT NUMBER OF REPORT

REPORT TITLE AND PERSONAL AUTHORS

ORIGINATING ACTIVITY *(Give specific Lab. or Div. and Location)*

REQUIRED FOR *(Explain need in detail, include applicable contracts)*

II. REQUESTING ORGANIZATION AND GOVERNMENT SPONSOR IDENTIFICATION

REQUESTING ORGANIZATION AND ADDRESS

SIGNATURE AND TITLE

USER CODE

FACILITY CLEARANCE

REGISTERED CONTRACT NUMBER

CONTRACT CLEARANCE

GOVERNMENT SPONSOR AND ADDRESS

CONTRACT MONITOR AND TELEPHONE NUMBER

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ADDRESS *(Street, City, State)*

☐ APPROVED FOR RELEASE TO REQUESTER IN SECTION II

☐ APPROVED FOR RELEASE TO ALL REGISTERED DDC USERS WITH ADEQUATE SECURITY CLEARANCE AND NEED-TO-KNOW

☐ DISAPPROVED. REASON FOR DISAPPROVAL:

TYPED NAME AND TITLE

SIGNATURE

DATE

DDC FORM 55 JAN 79

COPIES TO BE RETAINED: WHITE-DDC YELLOW-RELEASING AGENCY PINK-DDC SUSPENSE GOLD-REQUESTER

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

INSTRUCTIONS

A. ALL DDC USERS

1. Complete User Control Number block, if desired, for your internal control purposes.

2. Complete Sections I and II. In Section III, complete the Releasing Agency and address blocks only.

3. Enter all available bibliographic information in Section I for use by DDC and the releasing agency in document identification.

4. Explain in detail your requirement for the document in Section I.

5. Contractors and Grantees must identify in Section II their government sponsor including an appropriate individual's name and telephone number.

6. Indicate method of service charge payment in Section II, either as a charge to your NTIS deposit account or as a bill to your organization from NTIS. DDC will not accept any form of prepayment with this request. (Service charge will be made only for documents approved for release.)

7. Indicate type of copy and quantity requested in Section II. Microfiche will be supplied whenever possible if "Microform" is selected.

8. If classified information *must* be included, CLASSIFY THIS FORM.

9. If the document requested is CNWDI, certification that you are currently approved for access to CNWDI information must either be on file at DDC or furnished with this request.

10. Do not include payment or order cards with this request. Retain "Requester's copy" for your record and forward remaining three copies to:

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ATTN: DDC-DDR
Cameron Station
Alexandria, Virginia 22314

B. RELEASING AGENCY

1. Review the request. Contractor or Grantee government sponsor identification and contact point is included in Section II for your use, if necessary.

2. If approved only for specific requester identified in Section II, check that approval block, type name and title, sign and enter date in Section III. Retain "Releasing Agency copy" and return remaining copy to DDC.

3. If approved for all DDC users, check that approval block, type name and title, sign and enter date in Section III. Retain "Releasing Agency copy" and return remaining copy to DDC. NOTE: When this block is checked the existing distribution limitation assigned to the report is retained, but you are giving DDC the authority to release your limited document to all registered DDC users who are cleared for the security level and subject area of the document.

4. If disapproved, check disapproval block, type name and title, sign, enter date and explain reason for disapproval in Section III. Retain "Releasing Agency copy" and return remaining copy to DDC.

5. As directed by OUSDR&E (R&AT), DoD releasing agencies should:

   a. Complete this form and return it to DDC within 15 days.

   b. Reexamine the need for a limited distribution statement on this document and, if possible, authorize its removal. To document this review, a memorandum indicating that the limitation statement can be removed or explaining why it cannot be removed should also be sent to DDC.

APPENDIX A-8

Department of Energy (DOE)
Technical Information Center (TIC)
P.O. Box 62
Oakridge, Tennessee 37830, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*

The US Department of Energy Technical Information Center, located in Oakridge, Tennessee, is DOE's central point for collecting, processing, announcing and disseminating the world's technical and scientific literature on energy. From this input, TIC creates a number of bibliographic data bases from which TIC publishes a number of announcement journals.

(b) *Sources of data and material distributed.*

TIC acquires all technical reports issued routinely by DOE offices and contractors for processing, distribution in full-size to official addresses, microfiching for sale to official addresses, for transmittal to NTIS for further sale, and for announcing in TIC's abstracting and indexing journals. TIC also acquires full-size copies of energy literature by purchase or through exchange agreements. TIC obtains bibliographic citations and abstracts for the remainder of the world's energy literature on magnetic tape for indexing, processing, and announcement.

(c) *Size of collection(s).*

TIC maintains an archive of approximately 500,000 technical reports issued by the AEC, ERDA, and DOE.

(d) *Listing of data banks – include description.*

Energy Data Base – contains approximately one million entries,with bibliographic citation, abstract, and subject indexing to the world's scientific and technical information of interest to DOE.

General and Practical Data Base – contains over 10,000 entries on energy information available as mass-media products, such as pamphlets, booklets, films, posters, and technical information for the public or the layman.

Research-in-Progress Data Base – contains over 15,000 records on energy or energy-related research projects.

(e) *How is material accessioned and retrieved?*

DOE reports can be accessioned from TIC for official requesters, or from NTIS for non-official requesters. TIC publications can be accessioned from TIC, GPO, or NTIS. Citations from the TIC data bases may be accessioned and retrieved from DOE/RECON for official requesters, or by non-official requesters from three processors: the Western Regional Information Service Center, NERAC, or the University of Georgia Computer Center.

(f) *National policies affecting dissemination.*

The National policy affecting dissemination is that of encouraging wide dissemination of information.

(g) *Initial distribution policy and methods.*

DOE reports printed in sufficient quantities are distributed free in full-size copies to official addresses. Other DOE reports are sold through the microfiche facility to official addresses, and by NTIS. TIC a&i journals are free to official addresses and exchange partners. All initial distribution is made from the TIC facility.

(h) *Secondary distribution policy and methods.*

Official requesters may obtain full-size copies of DOE publications free from TIC, if TIC has full-size copies in stock. Otherwise, secondary distribution is made by purchase from NTIS, GPO, or the TIC microfiche facility.

(i) *Restrictions on dissemination.*

National defense considerations cause restrictions on the dissemination of a small number of DOE reports, and DOE reports in certain technology areas are disseminated outside the US only in exchange for similar type information.

(j) *Who can access the information?*

Any US individual or organization can access unclassified information. Foreign nationals and organizations do not have access to certain DOE reports, and to TIC's data bases except on an exchange basis.

(k) *Method of domestic access.*

Official requesters can obtain DOE publications direct from TIC, and access TIC's data bases on DOE/RECON. Others can obtain DOE publications from NTIS or GPO, and access TIC's data bases through the information processors given in the answer to question (e) above.

(l) *Method of foreign access if permitted.*
Foreign requesters can purchase most DOE publications from NTIS or GPO, and obtain the others from TIC on an exchange basis. Foreign requesters may obtain TIC's data base on an exchange basis.

(m) *User registration method if required.*
None required.

(n) *Announcement media.*
TIC publishes a number of abstracting and indexing announcement journals, and has a number of reports and booklets describing TIC's products and services.

(o) *Is material sold or loaned or both?*
Material is sold, given away free, or exchanged. The only loans made are non-English publications which may be the only copy held in the US.

(p) *Cost and method of payment for material and services.*
The cost is variable depending upon the material and service being provided.

(q) *Request and registration forms (samples).*
No special form required.

(r) *Promotional material available.*
A variety of promotional materials are available from TIC.

(s) *What aspects of your operation are automated?*
All bibliographic data are input to the TIC computer through an on-line CRT-terminal system, processed by computer, and repro-copy output produced by computer. Report distribution is semi-automated. Various administrative files are also automated.

(t) *Guidelines for access to sensitive material.*
Guidelines are those required for national defense.

(u) *Conditions for release of material.*
Conditions vary.

(v) *Translation services and material availability.*
TIC performs as a clearing house for information on translations of publications pertaining to energy made or in progress. A translations list is published. Translation service can be arranged by TIC for DOE offices.

(w) *Customer relation and user need services.*
TIC does not have a separate component devoted to customer relation and user need.

(x) *Future plans and developments.*
These depend upon future funding and staff levels thus are not so definite that they can be announced.

(y) *Staff and training (optional).*
TIC has a staff of about 230. Training is done on-the-job.

APPENDIX A-9

European Space Agency
ESRIN – Information Retrieval Service
via Galileo Galilei
0004 Frascati, Italy

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*

Information Retrieval Service (IRS) is the STI department of the European Space Agency which comprises 11 member states (Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden, Switzerland, United Kingdom). IRS is required to provide computer-based STI services to the Agency's staff, its Advisory Groups, its main contractors, and to the member states.

(b) *Sources of data and material distributed.*

NASA supplies its NASA File of aerospace abstracts as announced in STAR and IAA under the terms of an information exchange arrangement;

Many commercially available data bases such as Chemical Abstracts, INSPEC, COMPENDEX, etc. are maintained online;

A holding of NASA microfiches of NASA-sponsored reports (also supplied as part of the information exchange) is maintained.

(c) *Size of collection(s).*

Data bases cover the following broad subject areas:

Subject	*Name of data base*	*Time span*	*Refs/ month*
Aerospace	NASA	1962-	5,500
Agriculture	CAD	1973-	10,000
Aluminium	ALUMINUM	1968-	630
Biology	BIOSIS	1973-	20,000
Biology	PASCAL	1972-	40,000
Chemistry	CHEMABS	1969-	32,000
Computers/control	INSPEC	1971-	8,000
Electrical/electronics	INSPEC	1971-	
Electronic Components	ELECOMPS	1970-	2,000
Electronic Components	SPACECOMPS	1976-	280
Energy	ENERGYLINE	1971-	400
Engineering	COMPENDEX	1969-	8,400
Environmental Science	ENVIROLINE	1971-	760
Information Science	INSPEC INF	1971-	100
Mechanical Eng.	ISMEC	1973-	1,000
Medicine	PASCAL	1972-	40,000
Metallurgy	METADEX	1969-	2,600
Oceanography	OCEANIC	1964-	500
Physics	INSPEC	1971-	10,000
Pollution	POLLUTION	1970-	500
Sci/tech	NTIS	1970-	4,200
Sci/tech	PASCAL	1972-	40,000

(d) *Listing of data banks – include description.*

Answered above.

(e) *How is material accessioned and retrieved?*

On-line interactive information service.

(f) *National policies affecting dissemination*

IRS is available in each member state at the discretion of that member state, usually via the organ of a National Centre nominated by the government department concerned. Policies tend to differ in each country.

(g) *Initial distribution policy and methods.*

(See (h).)

(h) *Secondary distribution policy and methods.*
(Answer to both (g) and (h).) IRS provides a reference (or abstract) retrieval service but does not provide original documents other than NASA reports on demand.

(i) *Restrictions on dissemination.*
The on-line service is available throughout the member states. All requests from non-member states must be referred to the ESA Council. If access is approved a surcharge of 10 per cent is levied for all non-member state access. This recognizes that they have not contributed to the basic investment.

(j) *Who can access the information?*
Anyone requiring access must (subject to (i) above) sign a standard form of contract. If access to the NASA File is requested a Tripartite Form must also be signed and in-scope input must be provided.

(k) *Method of domestic access.*
(See (l).)

(l) *Method of foreign access if permitted.*
(Answer to both (k) and (l).) On-line in the following steps:
1. Choice of file.
2. Selection and logical combination of keywords.
3. Display of references and retention of those useful.

(m) *User registration method if required.*
Each user is assigned an I.D. which must be entered via his terminal during the logon procedure. The I.D. defines which files may be accessed.

(n) *Announcement media.*
Exhibitions, mailing of brochures etc., limited space advertising, conference presentations.

(o) *Is material sold or loaned or both?*
Hardwired terminal equipment is rented.
Microfiche copies and blow-back are sold.

(p) *Cost and method of payment for material and services.*
Various hourly rates dependent upon particular file accessed. Charges are invoiced monthly and payable in national currency at the official ESA rate.

(q) *Request and registration forms (samples).*
Used.

(r) *Promotional material available.*
Several brochures and a newsletter.

(s) *What aspects of your operation are automated?*
On-line interactive interrogation.
On-line data entry.
Statistics.
Invoicing.

(t) *Guidelines for access to sensitive material.*
No sensitive material currently on-line other than a small number of ELDO documents incorporated in the NASA File, requests for these must be sent to ESA HQ.

(v) *Translation services and material availability.*
Translation program for NASA covers about 100 ONERA and DLR reports annually.

(w) *Customer relation and user need services.*
IRS maintains a Customer Services Section of five staff currently who provide training and support to National Centre staff with a continuous program of seminars throughout the member states at beginner and advanced level, provide user manuals and associated material (e.g. newsletter NEWS and VIEWS).

(x) *Future plans and developments.*
There is a need to add more data bases to satisfy the demands of both existing and potential clients; retrieval software is being extensively developed; on-line data entry and private file services are being further developed and promoted; remote printout of search results over the network is being extended; on-line SDI profile entry has been introduced and will be promoted; connection to Euronet may reach wider market.

(z) *Comments.*

IRS has set up its own telecommunication network – ESANET – stretching more than 10,000 kilometers and extending through most West European countries; linked up with other communication Networks such as CYCLADES (France), TYMSHARE (Europe), CNUCE (Italy) to ensure wider access; IRS will also be available through the EURONET DIANE Service when introduced.

APPENDIX A-10

The Aeronautical Research Institute of Sweden (FFA)
P.O. Box 11021
S-161 11 Bromma, Sweden

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
FFA is concerned with research in the aeronautical field. The library gives service to about 50 scientists inside our Institute and also to other libraries all over Sweden, industrial as well as public and scientific ones.

(c) *Size of collection(s).*
Collections: About 10,000 books, 65,000 technical reports, 12,000 printed leaflets, 250 journals (subscriptions and exchange).

(d) *Listing of data banks – include description.*
In collaboration with the Armed Forces, Air Material Department, aeronautical technical reports in some Swedish libraries are indexed (COSATI) with lists every month.

(e) *How is material accessioned and retrieved?*
Books are catalogued manually and we use a classification system of our own.

(j) *Who can access the information?*
Open to our own staff and other libraries.

(l) *Method of foreign access if permitted.*
Possible for all Swedes to visit the library after permission from the librarian. (As we belong to the Defence, foreigners are not allowed to visit our Institute without special permission.)

(n) *Announcement media.*
Accession lists twice a month (125 copies) inside and outside our Institute.

(o) *Is material sold or loaned or both?*
Material is on loan.

(p) *Cost and method of payment for material and services.*
Service is free of charge (Xerox copies cost 0.50 Sw.Kr./copy outside our Institute).

(s) *What aspects of your operation are automated?*
None.

(t) *Guidelines for access to sensitive material.*
Sensitive material is not given on loan outside our Institute.

(w) *Customer relation and user need services.*
As our library is a special library in the aeronautical field (we are only a few in our country), and some of the material is exclusive, we consider it our duty to give service to others.

(y) *Staff and training (optional).*
The staff consists of 3[illegible] persons.

APPENDIX A-11

Forsvarets Forskning San Salt (FOA)
National Defence Research Institute
S-10450 Stockholm, Sweden

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The responsibility for Swedish defence research is vested in one establishment: FOA. The scope of the Institute is accordingly very wide. Apart from defence research, FOA serves Utrikes departementel – UD (The Ministry for Foreign Affairs) – with scientific background information. The five research departments of FOA have their own specialized local libraries. In addition, there is a central unit FOA Index providing computerized services to the department libraries.

(b) *Sources of data and material distributed.*
Ordered material, subscription to about 2500 journals (AD reports).

(c) *Size of collection(s).*
The library collections contain 80-90,000 documents growing at about 4000 new titles each year. It also has about 250,000 AD documents.

(d) *Listing of data banks – include description.*
Systems analysis weapons technology, applied electronics ABC research, human studies.

(e) *How is material accessioned and retrieved?*
Lists of recently acquired books, lists of periodicals SDI service based upon NTIS data base, retrospective services using DIALOG, ORBIT, RECON and New York Times.

(f) *National policies affecting dissemination.*
Classified documents are made available to users within the Swedish defence organization on a need to know basis.

(g) *Initial distribution policy and methods.*
Periodic listings, SDI, circulation, subscription service.

(h) *Secondary distribution policy and methods.*
Commercial retrospective searches.

(i) *Restrictions on dissemination.*
Classified documents are made available to users within the Swedish defence organization on a need to know basis.

(j) *Who can access the information?*
Primarily for internal use.

(k) *Method of domestic access.*
Unclassified documents published by FOA are available in Sweden by purchase or subscription.

(l) *Method of foreign access if permitted.*
Requests from defence agencies for reports should normally be made through that countries Defence Attache Office in Stockholm. Subscriptions through FOA Info, FACK S-104 50 Stockholm 80.

(n) *Announcement media.*
Periodic lists, SDI.

(o) *Is material sold or loaned or both?*
Both.

(r) *Promotional material available.*
Yes, "FOA in a nutshell".

(s) *What aspects of your operation are automated?*
Catalog card production, FOA periodic listings NTIS SDI, DIALOG, ORBIT, RECON, NYT.

(t) *Guidelines for access to sensitive material.*
Internal users only – need to know.

(u) *Conditions for release of material.*

(v) *Translation services and material availability.*

(x) *Future plans and developments.*
Experimental on-line system for documents arriving at and leaving the Institute.

APPENDIX A-12

Helsinki University of Technology Library
Otaniementie 9
SFO 2150 ESPOO 15
Finland

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
Helsinki University of Technology Library statutorily acts as the National Central Library for technology in Finland offering library and information services to anybody requiring scientific and technical information.

(b) *Sources of data and material distributed.*
Sources of data and material are acquired through purchase, exchanges and through the publishing activities of the University of Technology.

(c) *Size of collection(s).*
500,000 volumes of reports, periodicals and books. 500,000 reports on microfiche.

(d) *Listing of data banks – include description.*
The library maintains one data bank only, namely INIS, The International Nuclear Information System, created on a cooperative basis by the International Atomic Energy Agency.

The data base is searchable on-line by customers in Denmark, Finland, Norway and Sweden through the information and documentation dedicated network SCANNET.

(e) *How is material accessioned and retrieved?*
Purchase is the major accessioning method. As regards publications of the university, a certain number of each report has to be deposited with the library and given to the library for dissemination.

(g) *Initial distribution policy and methods.*
Reports from the different departments of the University of Technology are distributed according to mailing lists.

(h) *Secondary distribution policy and methods.*
Secondary distribution is carried out on requests, free of charge to cooperating institutions and on payment to others.

(j) *Who can access the information?*
Anybody.

(k) *Method of domestic access.*
Reading room use, loans, photocopies, of not copyrighted, and inter-library loans.

(l) *Method of foreign access if permitted.*
Loans, delivery of photocopies if not copyrighted.

(m) *User registration method if required.*
No user registration required.

(n) *Announcement media.*
Lists of accessions are disseminated in close to 1000 copies. An annual AKWIC-Index is made of journal papers in Finnish periodicals and of reports in Finnish from Helsinki University of Technology and the National Center for Technical Research.

An AKWIC-Index is periodically compiled of dissertations and research papers of the university.

(o) *Is material sold or loaned or both?*
Both.

(p) *Cost and method of payment for material and services.*
Reports are sold at a standard price of $15.00, copies are supplied at a price of 25 cents/page and services are charged by hour of the work of an information specialist plus computer etc. costs. The costing policy is non-profit.

(q) *Request and registration forms (samples).*
Most requests are received by telex or by national or international inter-library service request forms. No special form for this library is required.

(r) *Promotional material available.*
Handouts in Finnish, Swedish and English are available.

(s) *What aspects of your operation are automated?*
The INIS on-line system is automated, the production of AKWIC indices also. Cataloging of library material and selective dissemination of information concerning accessions is also automated.

(t) *Guidelines for access to sensitive material.*
No sensitive material in the collections.

(v) *Translation services and material availability.*
Translation services are carried out helping library clients on the spot free of charge. For other translation services there is a charge.

(w) *Customer relation and user need services.*
The Information Department, and the Library Services Department of the library are responsible for customer relations and service.

(x) *Future plans and developments.*
An integrated automation of also other library functions than cataloging and on-line service to supplement the present COM outputs offline.

(y) *Staff and training (optional).*
The library and its ten departmental and ten institutional libraries have a total staff of 70 persons, 30 of these are graduates. User training is carried out e.g. concerning the user of various on-line systems, such as the ESA/ESRIN, Systems Development Corporation etc.

(z) *Comments.*
A heading without an answer should be interpreted as not relevant to our services.

APPENDIX A-13

International Atomic Energy Agency (IAEA)
Kavntner Ring 11, P.O. Box 590
A-1011 Vienna, Austria

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The International Nuclear Information System (INIS), operated by the International Atomic Energy Agency (IAEA) in collaboration with its Member States, provides access to the world's literature on the peaceful uses of nuclear science and technology. Collection of both input and output are completely decentralized. Only the processing, checking and merging of the data are centralized.

(b) *Sources of data and material distributed.*
Inputs received from member states through INIS Liaison Officers at a national level.

(c) *Size of collection(s).*
More than 440,000 documents and articles have been announced since INIS was put in operation in 1970. About 70,000 items are now announced each year.

(d) *Listing of data banks – include description.*
Twenty-three subject fields concerning every aspect of the peaceful uses of nuclear science and technology.

(e) *How is material accessioned and retrieved?*
The responsibility for identifying, cataloging, abstracting, and indexing the relevant information published within a country rests with the INIS Liaison Officer representing that country. The IAEA has the responsibility for merging the input from the Member States and publishing the results.

(f) *National policies affecting dissemination.*
Each INIS Liaison Officer has the exclusive rights for the dissemination of the collected information within his own country, except for the printed INIS Atomindex and the microfiche.

(h) *Secondary distribution policy and methods.*
Microfiche of the "non-conventional" literature announced in INIS Atomindex, available to the public. "Non-conventional" literature is defined as that, such as scientific and technical reports, patent documents, and non-commercially published theses and dissertations, which is not commercially available through the usual distribution channels.

(j) *Who can access the information?*
There are no restrictions on access to INIS Atomindex or the microfiche.

(k) *Method of domestic access.*
Access is through INIS Liaison Officers.

(l) *Method of foreign access if permitted.*
Access is through INIS Liaison Officers.

(n) *Announcement media.*
1. INIS Atomindex; a semi-monthly abstract journal available to the public on subscription. Each issue contains a main entry section (abstracts) and 5 indexes. The indexes are cumulated semi-annually.
2. Magnetic tapes in a variety of formats duplicating the information in the printed INIS Atomindex, but available only to participating Member States and international organizations.

(p) *Cost and method of payment for material and services.*
The annual subscription to INIS Atomindex (by surface mail from Vienna) is $200.00. Air mail delivery is $150.00 additional. The microfiche of "non-conventional" literature are $1 per document, irrespective of the number of microfiche involved.

(r) *Promotional material available.*
INIS newsletter, brochures.

(s) *What aspects of your operation are automated?*
Magnetic-tape service, INIS Atomindex generation record input, bibliographic data and abstract, four major files.

(w) *Customer relation and user need services.*
Direct inquiries to national INIS Liaison Officer.

(x) *Future plans and developments.*
In 1977 the IAEA commenced work on the establishment of an experimental cooperative system for direct on-line access to the INIS data base. Effectiveness to be assessed in 1979. Also cooperating with space documentation service of ESA and the International Institute for Applied Systems Analysis, exploring ways of further improving and developing the service.

APPENDIX A-14

International Translations Centre (ITC)
101 Doelen Straat
Delft, The Netherlands

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The objective of ITC is to improve and facilitate the use of literature published in less accessible languages and of interest to science and industry and also to promote international cooperation in this field. Its international board of Management is composed of representatives from participating national centers; namely: Belgium, Denmark, France, Federal Republic of Germany, Greece, The Netherlands, Norway, Spain, Sweden and Switzerland.

(b) *Sources of data and material distributed.*
Any organization or individual having translations available is invited to send notification to its national center or ITC or, deposit a copy in ITC. Bibliographic data is required including: author, title, name, year, volume, number of original periodical, number of pages, name of agency from which available, price when known and language. Periodicals must be romanized.

(c) *Size of collection(s).*
140,000 – not the primary function of ITC.

(d) *Listing of data banks – include description.*
Catalog giving access to over 500,000 translations mainly from East European and Asiatic scientific and technical literature into western languages. Some western to French, some Spanish.

(e) *How is material accessioned and retrieved?*
The data base will be available through EURONET, the European on-line Information Network. The information section handles some 800-1000 requests a month. Translated and filed alphabetically. Subject requests difficult.

(f) *National policies affecting dissemination.*
Foundation under Dutch law.

(i) *Restrictions on dissemination.*
None.

(j) *Who can access the information?*
Anyone.

(k) *Method of domestic access.*
Applicant must give full bibliographic data about the original. Information on the existence of a translation and its locations. Requests for reproduction are provided at the actual cost (with a small handling fee).

(n) *Announcement media.*
World Transindex announces 32,000 translations per year. Arranged by subject headings derived from COSATI. Includes source and author index. Five Year Cumulations, Journals in Translation (Joint Publication with British Lending Library Division) and Translation News.

(o) *Is material sold or loaned or both?*
Sold.

(p) *Cost and method of payment for material and services.*
Copy cost and small handling fee.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?*
World Transindex produced by means of PASCAL system.

(v) *Translation services and material availability.*
The center does not prepare translations nor order translators to prepare translations.

(z) *Comments.*
Basically a referral service.

APPENDIX A-15

Kungl Tekniska Hogskolans Bibliotek
Royal Institute of Technology Library (RITL)
S-100 44 Stockholm, Sweden

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The Information and Documentation Center of the Royal Institute of Technology Library provides a service primarily in support of the institute. The service essentially consists of SDI and retrospective searches of external data bases. SDI is a computerized current awareness service scanning 10,000 references weekly. Retrospective searches are performed interactively using different data bases with over 20,000,000 references.

(b) *Sources of data and material distributed.*
SDI references printed on cards mailed to users twice to four times a month. Retrospective search of field of interest available in one hour. Data bases searched are ESA/RECON, SDC/ORBIT and Lockheed/DIALOG, BLAISE, SPLEEN3.

(e) *How is material accessioned and retrieved?*
Computerized facilities.

(f) *National policies affecting dissemination.*
Since our start ten years ago we have been working on grants given by the government. These grants have permitted us to work out an SDI program called EPOS/VIRA for the SDI service that enables us to run many data bases in a uniform format and enter the search profiles in remote batch from a terminal. We are also acting as national center for the IRS-RECON system, i.e. we have a high-speed terminal here and also a concentrator for the RECON network.

(g) *Initial distribution policy and methods.*
SDI.

(h) *Secondary distribution policy and methods.*
Retrospective search.

(i) *Restrictions on dissemination.*
The service is mainly for Swedish users. We are also giving service to other Nordic countries but not too many countries outside the Nordic ones.

(j) *Who can access the information?*
Anyone in those countries mentioned above who needs information may demand help.

(k) *Method of domestic access.*
The SDI service is a decentralized batch service, i.e. we are responsible for running the tapes and maintaining the system. The formulation of the profiles is done not only within our organization, but also at about 20 different universities around the Nordic countries and within some industries. The profiles are then entered in remote batch to the central computer in Stockholm. This means that a person in need of information can discuss his problems with someone often at hand (geographic), while the system is still maintained in Stockholm.

(l) *Method of foreign access if permitted.*
By foreign access, here I mean outside the Nordic countries, we have special cooperation with some countries, for instance Portugal, who can access the SDI system in the same way as Nordic users. Otherwise we do not have many foreign questions. We are restricted by contracts with the data base producers of some of the data bases.

(m) *User registration method if required.*
We have a customer file stored in the computer. This customer file prints out labels to all profiles which have given output during the last search. This file is also used for invoicing. The customer file is built in the same way as the profile file.

(n) *Announcement media.*
We have some pamphlets in Swedish. Otherwise we are giving seminars within our institute and on different places around the country.

(o) *Is material sold or loaned or both?*

E Each information search is formulated for the individual customer. It is his unique problem and the result is his own to treat in the way he wants to. Some producers, however, have put restrictions for the use of information from specific data bases, and the customer has to follow these rules.

(p) *Cost and method of payment for material and services.*

The price for the SDI subscription is SwCr 880 per year and query. This price is regardless of the number of data bases used and number of references retrieved. The price for a retrospective search is dependent on the time spent at the terminal. One hour terminal time is charged at SwCr 800 regardless of system. An extra cost for a high volume of printed references is charged. The SDI service is invoiced annually in advance, retrospective services shortly after the result is received.

(q) *Request and registration forms (samples).*

There are no strict forms to be filled in.

(r) *Promotional material available.*

See under point (n).

(s) *What aspects of your operation are automated?*

For our services we are almost only using computerized systems.

(t) *Guidelines for access to sensitive material.*

No, we do not have any guidelines.

(u) *Conditions for release of material.*

Those conditions are data base dependent.

(v) *Translation services and material availability.*

The library is a member of International Translation Centre but we do not do any translations ourselves.

Requests for hard copies from references retrieved from the computerized services are channelized through the RIT Library to the appropriate library where the full material is available.

(w) *Customer relation and user need services.*

As far as possible we try to help everybody who comes with questions to us, regardless if it is in connection with a search or not. We try to keep the relations as informal as possible and do not always charge for service.

(x) *Future plans and developments.*

We are involved in the testing of a new Swedish interactive search system called 3RIP. During the next year we will implement some data bases not always already available. Among these data bases is our own data base in mechanical engineering, MechEn. The test will show if 3RIP is more economic and has better facilities than other big interactive systems and we will try to work with the users adaptions such as help facilities.

(y) *Staff and training (optional).*

The department within the RIT Library that is working with computerized information services, IDC, consists of 24 people. Of those 12 are information officers educated in different scientific disciplines, 3 are working with the maintenance of the systems, both the SDI service and 3RIP. One is typing our MechEn data base and the rest are working with administrative and clerical tasks. The training of the staff is mainly done in-house by practical work. Courses given by outside organizations such as SDC are attended.

We are also doing a lot of education and training of people outside our organization, mainly students within the Institute. This training involves manual literature searches as well as computerized searches. As a national center for RECON we are giving courses for those who want to use the system within Sweden and Finland. The organizations who want to use our SDI service in their work have to attend courses at IDC.

(z) *Comments.*

IDC is a department of the RIT Library and the service given is first of all adapted to the need of information by the researchers of the Institute. Since this service is available we try to help everybody in the country who wants this kind of service.

APPENDIX A-16

National Aeronautics and Space Administration (NASA)
Scientific and Technical Information Facility
P.O. Box 8757
Baltimore/Washington International Airport, MD 21240, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The NASA Scientific and Technical Information Facility serves as central repository for over 1.8 million items of aerospace derived technology. Collects and distributes to industry, to the academic community and to the interested public as well as to its own scientists and engineers the scientific and technical information which results from aerospace research.

(b) *Sources of data and material distributed.*
NASA Space and Aeronautical Research, NASA Centers, NASA contractors, other Government agencies and their contractors, private and university research institutions, and foreign governmental industrial and academic laboratories.

(c) *Size of collection(s).*
1.8 million including books and serials. STAR population is 425,000, IAA is 525,000 for a total of 950,000 accessions. Increasing at 90,000 per year.

(d) *Listing of data banks – include description.*
11 subject divisions, 75 categories.

(e) *How is material accessioned and retrieved?*
Staff of information specialists catalog and abstract bibliographic information; stored in facilities computer; material located by computerized search.

(f) *National policies affecting dissemination.*
NASA must provide the widest practicable and appropriate dissemination of information concerning its activities and results thereof.

(g) *Initial distribution policy and methods.*
Dissemination of hard copies of microfiche to registered users. "Selected Current Aerospace Notices" to NASA scientists and engineers and its contractors at two-week intervals.

(h) *Secondary distribution policy and methods.*
Available from sales source noted in STAR. Usually National Technical Information service and US Government Printing Office.

(i) *Restrictions on dissemination.*
Searches by registered users. Security classified and administratively restricted by official requirement.

(j) *Who can access the information?*
Registered users unless available from sales source.

(k) *Method of domestic access.*
Technology utilization program – 50,000 requests per year.

(l) *Method of foreign access if permitted.*
Sales source subject to restrictions of that source.

(m) *User registration method if required.*
Apply to facility.

(n) *Announcement media.*
Semi-monthly "Scientific and Technical Aerospace Reports (STAR)" presents 1000 document abstracts in 75 categories. Companion journal "International Aerospace Abstracts".

(o) *Is material sold or loaned or both?*
Free to libraries of US Government agencies and other certain public access libraries. Charge for others, automatic document distribution service (ADDS).

(p) *Cost and method of payment for material and services.*
Charge for ADPS, $2380 MF, $1810 formal reports subscription for STAR (US GPO) and IAA from AIAA.

(q) *Request and registration forms (samples).*
Used.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?*
NASA scientists and engineers and NASA contractors can use NASA/RECON.

(t) *Guidelines for access to sensitive material.*
LSTAR announces limited publications not available to general public.

(u) *Conditions for release of material.*
Varies.

(v) *Translation services and material availability.*
NASA Technical Translations, number series NASA TTF-(#).

(w) *Customer relation and user need services.*
STAR, other announcement journals for special needs.

(y) *Staff and training (optional).*
230 people including professional researchers.

APPENDIX A-17

National Technical Information Service (NTIS)
Springfield, Va. 22161, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The NTIS of the US Department of Commerce is the central source for the public sale of US and foreign government-sponsored research, development and engineering reports and other analyses prepared by national and local governmental agencies, their contractors or grantees, or by Special Technology Groups. NTIS is also the central source for federally generated machine processable data files and manages the Federal Software Exchange Center. Distributes microform, paper copy, subscription products, computer products.

(b) *Sources of data and material distributed.*
Government agencies, US corporations and universities under contract to meet specific objectives of Government agencies. 150,000 report titles are of foreign origin.

(c) *Size of collection(s).*
Collection exceeds one million titles.

(d) *Listing of data banks – include description.*
Many special categories, includes Government owned inventions, foreign technology, exports and imports, Energy, Environment, Local government.

(e) *How is material accessioned and retrieved?*
File elements include: report title, personal or corporate author, accession or contract number, subject, key words, descriptors, or subject codes.

(f) *National policies affecting dissemination.*
NTIS products and services are intended to increase the efficiency and effectiveness of the US R&D enterprise, and to support US foreign policy goals by assisting social and economic development of other nations.

(g) *Initial distribution policy and methods.*
Standing Order Microfiche Service – "SRIM". Automatic distribution of paper copies.

(h) *Secondary distribution policy and methods.*
Individual document order.

(i) *Restrictions on dissemination.*
See (l).

(j) *Who can access the information?*
Anyone.

(l) *Method of foreign access if permitted.*
Foreign customers whose orders are destined for countries in which NTIS has appointed managing dealers must order through those dealers. Dealers are:

The Netherlands
INTERMEDIAIR
Kelzersgracht 391
Amsterdam, Postbus 3434

Brazil
Nucleo de Informacoes Technologicas
Barros Learn Producoes Didaticas LTOA
Rua 24 deMaio 62, Caixa Postal 6182,
01000 San Paulo, S-P.

United Kingdom
Republic Of Ireland
MICROINFO Ltd
Alton, Hampshire GO34IEF

France, Belgium, and Switzerland
Center for Business Information
7 rue Buffon
75005 Paris

Japan
Mitsubishi-Research Institute, Inc.
1-8-1 Yuraku-Cho
Chiyoda-Ku
Tokyo 100

Mexico
INFOTEC/CONACYT
Division NTIS
Apt. 20, Postal 19-194
Mexico 12 D.F.
Mexico 19 D.F.

(n) *Announcement media.*
Government Reports Announcements and Index NTIS Bibliographic Data File (Mag. Tape) Tech. notes, 33 Abstract Newsletters.

(o) *Is material sold or loaned or both?*
Sold, leased, some information free.

(p) *Cost and method of payment for material and services.*
Costs vary. Methods – Deposit account, American Express, ship and bill with surcharge. NTIS foreign prices apply outside North America.

(q) *Request and registration forms (samples).*
Request forms used.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?*
NTIS Search gives 680,000 federally sponsored research report summaries on-line. NTIS Bibliographic Data File.

(v) *Translation services and material availability.*
80,000 reports since 1957 by Joint Publications Research Service. Mostly concerned with communist countries.

(w) *Customer relation and user need services.*
Many special services. See NTIS Information Services General Catalog #6 for North America.

(z) *Comments.*
NTIS ships about 23,000 information products daily. Supplies its customers with about six million documents and microforms annually. NTIS is directed to recover costs from sales of products and services. At least 26 million referrals are made to specific titles in the NTIS system.

APPENDIX A-18

National Translations Center (NTC)
The John Crerar Library
35 West 33rd Street
Chicago, Illinois 60516, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
NTC serves as an international depository and information source for translations of the world's scientific and technical literature available from any known source in the US and other English Speaking Countries.

(b) *Sources of data and material distributed.*
The Center's collection has been accumulated through deposits from governmental, industrial, academic and other professional organizations willing to share translations.

(c) *Size of collection(s).*
260,000 individual translations available at the Center. The collection grows at a rate of 10,000 to 12,000 translations per year.

(d) *Listing of data banks – include description.*
NTC has records of almost 1,000,000 individual translations in some 40 languages. About 1500 new availability records are added to catalog files each month.

(e) *How is material accessioned and retrieved?*
Translation Register – Index (TR-I). Translation Register lists selected translations organized in subject arrangement following COSATI Subject Classification System. The Index Section is computer produced semi-annually and annually.

(g) *Initial distribution policy and methods.*
TR-I is the Center's monthly listing and citation index for new materials.

(h) *Secondary distribution policy and methods.*
NTC provides availability information through a service/subscription program. After confirmation of availability the client can acquire a copy from the indicated source or from the Center itself if on file.

(j) *Who can access the information?*
Anyone.

(k) *Method of domestic access.*
Telephone, teletype or mail. (312) 225-2526,
TNX-910-221-5131.

(n) *Announcement media.*
All newly available translations, regardless of source from which they can be obtained, are announced in the Center's monthly translations accession bulletin TR-I.

(o) *Is material sold or loaned or both?*
See (z).

(p) *Cost and method of payment for material and services.*
TR-I yearly subscription $65.00 per year. See (z). If available from the Center, translation copies are $10.50 first ten pages plus $2.25 for each additional 10 pages or fraction thereof.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?*
Index computer produced.

(v) *Translation services and material availability.*
Translation services are not available.

(w) *Customer relation and user need services.*
See (z).

(y) *Staff and training (optional).*
Staff of four, two professionals and two clerk-typists.

(z) *Comments.*
See attached letter.

NTC SERVICE/SUBSCRIPTION PLANS – NTC TRANSLATION AVAILABILITY SEARCH FEE SCHEDULE

The National Translations Center is continuing its program of free access to NTC files for depositors donating translations to the Center's collection.

Under the terms of the NTC subscription/service program, information from the Center's data files regarding the availability of translations can be obtained in several ways. Those who both produce and acquire large numbers of translations can join the Center in a program which is mutually beneficial. The deposit in or contribution of copies of translations to the Center will entitle the donors to receive information reports about the availability of other translations which they may need.

Calendar year 1975, served as the basis for instituting the new procedures in 1976. New depositors in 1976, automatically and immediately became eligible for whatever category (number of translations deposited) they qualified for. This policy will continue.

The categories are:

1. 1-20 translations deposited. Free access on a one-to-one basis. Additional reports, if needed, will be supplied at a fee of $3.00 per item searched.
2. 20-40 translations deposited. 40 free availability searches. If more than 40 are needed additional inquiries will be processed at $3.00 per item searched.
3. Over 40 translations deposited. Unlimited access. Any organization which wishes to deposit more than 40 translations at any given time immediately qualifies for unlimited free reports during the present and succeeding years (i.e., 76-77; 77-78). This includes back-file translations as well as current material.
4. Subscribers to *Translations Register – Index* who do not or cannot deposit translations in the Center can obtain information reports as needed at a fee of $3.00 per item searched.
5. Occasional users of NTC, who are neither depositors nor subscribers to *Translations Register – Index*, can obtain information and availability reports at a fee of $5.00 per item.

Organizations wishing further information or a status report on your credit with NTC may address inquiries to:

The Chief
National Translations Center
John Crerar Library
35 West 33rd Street
Chicago, Illinois 60516, USA.

APPENDIX A-19

Smithsonian Science Information Exchange Inc. (SSIE)
Room 300
1730 M Street
Washington D.C. 20036, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
The SSIE was established in 1949 in support of medical sciences. Today SSIE processes information on more than 100,000 research projects each year, in all areas of basic and applied research in the life and physical sciences. It regularly provides ongoing research information and information services to a steadily growing number of users in the United States and overseas.

(b) *Sources of data and material distributed.*
SSIE receives project information from US Federal Government agencies, state and local governmental agencies, non-profit associations and foundations, colleges and universities and foreign research organizations; over 1300 different sources in all.

(c) *Size of collection(s).*
More than 200,000 ongoing or recently completed projects.

(d) *Listing of data banks – include description.*
Basic record is the single-page Notice of Research Project (NRP) giving 200-word abstract, project title supporting organization, investigator, period, funding etc.

(e) *How is material accessioned and retrieved?*
Professional staff responsible for subject indexing and retrieval.

(f) *National policies affecting dissemination.*
Bridge critical information gap between the time a research project is initiated and results available.

(g) *Initial distribution policy and methods.*
Monthly SDI service (standard).

(h) *Secondary distribution policy and methods.*
Custom searches and quarterly SDI updates, investigator searches, accession number retrieval, administrative tabulations, research and information packages.

(j) *Who can access the information?*
No restrictions.

(k) *Method of domestic access.*
Letter, telephone, request form.

(l) *Method of foreign access if permitted.*
Letter, telephone, request form.

(n) *Announcement media.*
Available.

(o) *Is material sold or loaned or both?*
Sold.

(p) *Cost and method of payment for material and services.*
Prepaid or charge account, 10% added for postage and handling outside the US, Canada or Mexico.

(q) *Request and registration forms (samples).*
Request form optional.

(r) *Promotional material available.*
Yes.

(s) *What aspects of your operation are automated?*
SSIE data base accessible through "ORBIT" or "DIALOG" Internal File Search automated.

APPENDIX A-20

US Government Printing Office (GPO)
Washington D.C. 20402, USA

DISSEMINATION PRACTICES

(a) *Charter or description of facility and service.*
Each year the several departments offices and agencies of the Federal Government prepare and release tens of thousands of publications for the consumer. The superintendent of documents provides nearly 25,000 different titles broken down into subscriptions and publications for sale to both domestic and foreign customers.

(b) *Sources of data and material distributed.*
Federal Government.

(d) *Listing of data banks – include description.*
No central listing.

(e) *How is material accessioned and retrieved?*
No single hard copy catalog is available but subject bibliographies are offered.

(f) *National policies affecting dissemination.*
Sale of federal publications must be on a self-sustaining basis.

(g) *Initial distribution policy and methods.*
Subscription sales – over 400 different dated periodicals and basic manuals with supplementary material.

(h) *Secondary distribution policy and methods.*
Individual order.

(i) *Restrictions on dissemination.*
Government publications often contain copyrighted material which is used with permission of copyright owner, publication in a Government document does not authorize any use or appropriation of such copyright material without consent of the owner.

(j) *Who can access the information?*
Anyone.

(k) *Method of domestic access.*
Address inquiry to point shown in promotional material.

(l) *Method of foreign access if permitted.*
Permitted – same access – 25% surcharge.

(n) *Announcement media.*
GPO sales Publication Reference File (PRF) – 4 x 8 microfiche, $50.00 per year domestic, $62.50 per year foreign, 250 subject bibliographies on various subjects.

(o) *Is material sold or loaned or both?*
Sold – some free.

(p) *Cost and method of payment for material and services.*
Minimum order $1.00 foreign orders are subject to a 25 percent surcharge. GPO Publication Sales Reference File Update (PRFSU) $5.00 domestic, $6.25 foreign.

(q) *Request and registration forms (samples).*
Various order forms.

(r) *Promotional material available.*
Yes.

(w) *Customer relation and user need services.*
When unsure of proper source, contact your nearest Federal Information Center.

(y) *Staff and training (optional).*

Sales organization consists of nearly 1000 professionals, technicians and clerks.

(z) *Comments.*

Remittance is required in advance of shipping by Master Charge, VISA, draft on a United States or Canadian bank, by UNESCO Coupons or International Postal money order made payable to the Superintendant of Documents. All orders must be in English.

APPENDIX B

DOCUMENT REQUESTS PROCEDURES
(Design of Forms, Processing of Requests)

1. INTRODUCTION

One of the basic services provided by scientific and technical information centres is the supply of documents in response to specific requests. This activity is increasingly becoming known as secondary distribution. In order to avoid irrelevant requests, it is important that the terms of reference of such centres, and their publicity material adequately identify the categories of documents for which they are responsible. The parameters defining these categories include: subject; classification/releasability; and origin.

2. SOURCES OF INFORMATION RELATING TO DOCUMENT REQUESTS

The sources from which requesters will gain knowledge of documents of interest comprise principally: (i) current awareness announcements (abstracts bulletins, accessions lists, SDI listings, etc.); (ii) citations in the literature; and (iii) retrospective bibliographies and the results of literature searches. Hopefully the citations in these three media will provide sufficient information for the unambiguous identification of the required items.

However, a proportion of requests will arise from more tenuous origins: the requester's own recollection of documents or references seen at an earlier date; scribbled notes made at conferences, meetings or discussions where only passing reference has been made to relevant papers; the requester's own card index to the literature, etc. In these cases, it will not be surprising if the information supplied in support of a request is deficient to some degree.

3. THE NEED FOR A STANDARD REQUEST FORM

In order to encourage the orderly presentation of adequate information it is strongly recommended that a standard document request form is used. A cardinal principle is that only one document should be requested on one form. The problems of progressing different requests entered on the same form are thus avoided.

4. FORM DESIGN

Increasingly, the practice is to use multipart stationery for document request forms. A typical document request form is shown on page 114 which illustrates the request form in use at the Defence Research Information Centre of the United Kingdom Ministry of Defence Procurement Executive. This is a three-part form with interleaved carbon. The top copy (white) is the requester's reference copy and includes notes on completion of the form. The second and third copies are for use by the Reports Centre, the second copy (yellow) being used as an action copy until the request is cleared, during which time the third copy (pink) is retained as a reference copy. At the time the request is cleared, the pink copy is used as a despatch note. The address section top left is perforated and gummed and can be used as an address label, while the remainder, being despatched with the document, allows the requester to match the incoming document with his original demand. At the time of despatch the yellow copy is filed away in numerical order. Thus all yellow forms in the file represent completed requests while all pink forms indicate outstanding requests.

There are arguments for and against pre-numbered forms. However, the pre-printed serial number on the request form does allow: (i) the requester, (ii) the documentation centre to which the request has been despatched, and (iii) any third party to whom application for the document may have to be made, readily to identify the request in question. It also facilitates unambiguous filing of the request forms.

In addition to sections for the usual bibliographical elements of the requested document (title, originator, document reference number, date of publication, accession number, etc.), the form should allow for the format in which the document is to be despatched to be indicated. One can thus, hopefully, encourage the use of microfiches – an advantage to the information centre if not necessarily to the end user.

It is common practice for document request forms to include a statement, to be certified by the applicant, limiting the purposes for which the requested document is required. This statement is intended as a precaution against infringement of the copyright of the document being supplied.

As a large proportion (if not all) of the report holdings of defence information centres have limitations on their availability, it is also necessary to provide a section on the form where the requester can detail the context in which the requested document is required. On the DRIC form shown on page 114, provision is also made for entering details of the relevant Ministry of Defence Project Officer; this facilitates validation of the applicant's requirement. Alternatively, a register of authorised users may be maintained, and limited distribution and classified documents released only when the subject content of the requested document matches the registered field of interest of the user.

5. PROCESSING OF REQUESTS

The first action on receipt of a request should be to stamp the date of receipt. Such a date is of material assistance when resolving queries in respect of delays in fulfilling requests.

The next step will be to establish whether the requested report is available from stock. If so, any necessary clearance actions should then be taken.

For documents originated in the parent Defence Department of the Defence Information Centre this may involve clearances in respect of patent rights, proprietary rights, validation of "need-to-know", and a check on the authority of the recipient to receive material of the classification in question.

For documents originated outside the parent Defence Department, and this second category includes, of course, documents received from overseas, care must be taken that document releases are effected strictly in accordance with the Conditions of Release upon which they have been supplied.

Where documents cannot be traced in the information centre's holdings, a decision must be made as to whether the requested items should be acquired or whether the requesters should be advised to apply to alternative sources. For requests which have only partial information, the printed indexes to publications such as the US National Technical Information Service Government Reports Announcements (NTIS GRA) and the National Aeronautics and Space Administration's Scientific and Technical Aerospace Reports (NASA STAR) are useful in tracking down and identifying specific documents. Cumulations of these indexes, and others, may be interactively searched using on-line connections to computerised information services.

Irrespective of the cause, when a request cannot be met from stock, it is strongly recommended that receipt of the request is acknowledged. It will be appreciated by the user if this acknowledgement is made by way of a standard letter giving the reason for the delay or non-fulfilment of the request. Typical reasons for non-supply of documents may include: all stock copies on loan – copy being recalled; document not held – action being taken to acquire; document not held – alternative source suggested; document cannot be identified from information supplied – further details requested.

When it has been decided to acquire a document not held from an alternative source, the action copy of the request form may be used. Such outstanding requests should be progressed at appropriate intervals.

6. CONCLUSION

It is axiomatic that in fulfilling requests for documents, one is meeting a specific and stated need. This service is thus fundamental to the role of technical information centres, whereas some other services, e.g. current awareness and primary distribution, are to some extent speculative. Methodical and prompt procedures for dealing with report requests are fundamental requirements for an efficient scientific and technical information centre.

J.C.Dunne,
UK/DRIC

SERIAL No. 425003

Defence Research Information Centre
REQUEST FOR DOCUMENT

To : D.R.I.C.
Station Square House
St. Mary Cray
Orpington
Kent BR5 3RE

NOTES ON COMPILATION

1. Ensure that all copies are legible; this is best achieved by typing.
2. Complete a separate set of forms for each request.
3. Quote full bibliographical details.
4. Avoid quoting the titles of classified reports if these documents can be positively identified in any other way ; if classified information is cited, the request forms must be safeguarded in accordance with the regulations.
5. Retain the top copy (WHITE) for reference ; forward the second (YELLOW) and third (PINK) copies to DRIC.

REQUESTER'S REFERENCE COPY

1. FROM (Please enter name, branch/establishment/organisation, and address above; pink copy will be used as address label for posting documents).

2. Please supply on loan/retention.....copy/copies of TITLE (of report/specification/translation) :

3. ORIGINATOR

4. DOCUMENT REFERENCE No.

5. DATE of issue

6. AUTHOR

7. WHERE QUOTED :

8. Accession Number

9. FORMAT
Microfiche :
preferred ☐
acceptable ☐
not acceptable ☐

10. I certify that this document is required only for purposes of research or private study and that there is a UK Government defence "need-to-know" for controlled or classified information requested. The relevant defence contract/MOD research programme is.....The MOD sponsor is.....

Signature.....Name block letters.....Rank.....Date.....

DRIC REQ 1

J B Ltd 56 ST Dd 343115 7 79

Section 9

MICROFORM SYSTEMS AND REPROGRAPHY

by
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United Kingdom

ABSTRACT

This section covers the preparation and reproduction of research and development publications. Technical details of reprographic and microfilm processes are outlined in order to show the main factors involved in setting up publication facilities. The requirements for equipment and staff resources are discussed and cost elements are identified in broad terms. The application of computer output on microfilm (COM) is outlined and a review of the practical aspects of quality control for publications in both paper and microfilm media is included.

CONTENTS

	Page
LIST OF TABLES	119
LIST OF FIGURES	120
1. INTRODUCTION	121
1.1 Aims	121
1.2 Categories of Material	121
1.3 Report Production	121
2. PUBLICATION REQUIREMENTS	121
2.1 The Needs of the Reader	121
2.2 Appearance	123
2.3 Speed of Publication	123
2.4 Half-tone Illustrations	123
2.4.1 Continuous-tone Reproduction	123
2.4.2 Half-tone Litho Reproduction	123
2.4.3 Tone Reproduction on Microfilm	124
2.4.4 Tone Reproduction in Photocopying	124
2.5 Colour Reproduction	124
2.5.1 Line-colour Printing	124
2.5.2 Half-tone Colour Printing	125
2.5.3 Colour Microfilming	125
2.6 Special Symbols	125
2.7 Security Regulations	125
2.8 Economy	125
2.8.1 Materials	126
2.8.2 Labour	126
2.8.3 Equipment	126
2.8.4 Productivity	127
3. PREPARATION OF MATERIAL FOR REPRODUCTION	127
3.1 Preparation of Author's Manuscript	127
3.2 Text Preparation for Offset Lithography	127
3.2.1 Equipment	127
3.2.2 Typographic features	127
3.2.3 Word Processing and Computer-aided Text Preparation	131
3.3 Line Illustrations	133
3.3.1 Line Work	133
3.3.2 Coloured Line Work	133
3.3.3 Lettering for Illustrations	133
3.4 Tone Illustrations	134
3.4.1 Bromide Prints	134
3.4.2 Screening of Continuous-tone Materials	136
3.4.3 Pre-screened Material	137
3.4.4 Colour Photographs	138
3.4.5 Presentation of Photographs	138
3.5 Camera Copy for Microfilming	138
3.6 House Style	138
3.6.1 Reports	138
3.6.2 Conference Papers	138
3.6.3 Preparation Standards	139
4. REPROGRAPHY	139
4.1 Photocopying, Duplicating and Printing	139
4.1.1 Photocopying	139
4.1.2 Duplicating	139
4.1.3 Printing	139
4.1.4 Summary	140
4.2 Reprographic Processes	140
4.3 Stencil Duplicating	140
4.4 Spirit duplicating	141

	Page
4.5 Electrophotography	141
4.5.1 Background	141
4.5.2 Electrophotographic Copiers	142
4.5.3 Electrophotographic Micro-printers	142
4.5.4 Photocopier output	142
4.6 Offset Lithography	143
4.6.1 Background	143
4.6.2 The Offset Process	143
4.6.3 Metal Plates	144
4.6.4 Plastic and Paper Plates	144
4.6.5 Litho Machines	144
4.7 Finishing	146
4.7.1 Checking	146
4.7.2 Collating	146
4.7.3 Binding	146
4.7.4 Folding, Trimming etc.	147
4.8 Re-orders	147
5. MICROFILM SYSTEMS	148
5.1 Microfilm Formats	148
5.1.1 Roll Film	148
5.1.2 Aperture Cards	149
5.1.3 Microfiche	149
5.1.4 Selection of Microfilm Format	149
5.1.5 Microfilm Image Polarity	149
5.2 Microfilm Features	151
5.2.1 Summary of Advantages	151
5.2.2 Economy in Space	152
5.2.3 Microfilm Security	152
5.2.4 Microfilm Duplicates and Reprints	153
5.2.5 Postal Charges and Transportation	154
5.2.6 Microfilm Print-out	154
5.2.7 Access	154
5.3 Microfilm Materials	155
5.3.1 Silver Halide Films	155
5.3.2 Diazo Materials	155
5.3.3 Vesicular Materials	155
5.3.4 Unconventional Materials	156
5.3.5 Microfilm Print-out Materials	156
5.3.6 Storage Conditions	156
5.4 Microfilm Equipment and Methods	157
5.4.1 Microfilm Cameras	158
5.4.2 Film Processors	158
5.4.3 Quality Control Equipment	160
5.4.4 Jacket Filler	160
5.4.5 Microfilm Duplicators	160
5.4.6 Microfilm Readers	160
5.4.7 Microfilm Reader-printers	161
5.5 Computer Output Microfilm (COM)	161
5.5.1 Applications of COM	161
5.5.2 The COM System	161
5.5.3 COM Performance	162
5.5.4 Graphical COM	162
5.5.5 Features of COM	162
5.5.6 COM Processing	164
5.6 Computer Input from Microfilm (CIM)	165
5.7 Microfilm Retrieval	165
5.7.1 Microfiche Retrieval	165
5.7.2 Roll Film Retrieval	165
5.8 System Design	166
6. QUALITY CONTROL	166
6.1 Printed Publications	166
6.1.1 Quality Assurance	166
6.1.2 Defects	166

	Page
6.1.3 Format Standards	168
6.1.4 Defect Analysis	168
6.2 Checking Microfilm	168
6.2.1 Microfilm Dimensions	170
6.2.2 Microfilm Resolving Power	170
6.2.3 Microfilm Density	171
6.2.4 Tests for Image Permanence	172
6.2.5 Image Sequence	172
7. STAFFING	172
7.1 Introduction	172
7.2 Job Categories	172
7.3 Organisation	173
7.4 Staff Numbers	173
7.5 Training	174
7.5.1 Training Programme	174
7.5.2 Training and Education	174
Appendix A NATIONAL MICROFILM SOCIETIES	176
Appendix B PUBLICATION COSTS	177
B.1 INTRODUCTION	177
B.2 COST VARIATIONS	177
B.3 COST FRAMEWORK	177
B.4 STAFF COSTS	178
B.5 EQUIPMENT COSTS	178
B.5.1 Purchase	178
B.5.2 Installation	179
B.5.3 Equipment expenses	179
B.5.4 Equipment Rental	180
B.6 MATERIAL COSTS	181
B.7 SUMMARY OF PRODUCTION COSTS	181
B.8 BUREAU COSTS	181
B.9 COMPARISON OF INTERNAL AND BUREAU COSTS	182
B.9.1 Litho Printing	182
B.9.2 Microfilming	182
B.10 SUMMARY	182
BIBLIOGRAPHY	183
1. REPROGRAPHY	183
2. MICROFILM	183
3. JOURNALS	183
REFERENCES	184

LIST OF TABLES

		Page
Table 1	Features of Text Preparation Equipment	128
Table 2	Comparison of Typewriters and Word Processors	131
Table 3	Applications of Reprographic processes	141
Table 4	Photocopier Output – A Worked Example	143
Table 5	Printed Publications – A Quality Check List	167
Table 6	Example of Staff Structure and Costs	178
Table 7	Major Items of Report Production Equipment (approx. UK prices. mid-1979)	179
Table 8	Annual Depreciation – A Worked Example	180
Table 9	Summary of Internal Production Costs – A Worked Example	181

LIST OF FIGURES

		Page
Figure 1	Stages in the production of R & D publications	122
Figure 2	Typographic features of typewriting	129
Figure 3	Technical symbols for scientific reports	130
Figure 4	Word processing configurations	132
Figure 5	Line-colour reproduction – bureau costs	134
Figure 6	Use of bromide prints for illustration	135
Figure 7	Production of illustrations – cost of bromide prints and offset litho half-tone prints	136
Figure 8	Production methods for half-tone illustrations	137
Figure 9	Principles of the major printing processes	140
Figure 10	Reprographic equipment	145
Figure 11	Methods of binding	147
Figure 12	Offset litho printing: cost v run length	148
Figure 13	Standard microfiche formats	150
Figure 14	Reduced storage space required for microfilm	153
Figure 15	Cost comparison: microcopying v photocopying	154
Figure 16	Microfilm equipment chain	157
Figure 17	Microfilm equipment	159
Figure 18	Basic COM system	161
Figure 19	Examples of COM output	163
Figure 20	COM processing procedure	164
Figure 21	Checking routine for scientific publications	169
Figure 22	Microfilm density levels	171
Figure 23	Publication unit – possible supervisory structure	173

1. INTRODUCTION

1.1 Aims

Some readers of this Manual have responsibility for the writing of reports, others are more concerned with their storage and retrieval. This Section seeks to bridge the gap between these two activities; to cover the ground between the completion of the author's work and the delivery of the finished publication to the user. It is hoped that this will be of interest to all those concerned with the effective presentation of scientific and technical information, in both paper and microfilm media.

The main factors affecting process selection are outlined and operational details are discussed, without any claims to present a full survey of current equipment or to offer a detailed theoretical treatment. The main aim is to give a broad appreciation of current practice and an understanding of the implications of setting up a unit for producing scientific documentation. It is assumed that readers will have access to professional reprographic staff for the further explanation of technicalities and demonstration of practical details.

Organisational aspects are mentioned mainly in the context of the smaller research establishment, rather than the large information centres. Where cost figures are shown, they relate to UK levels in mid-1979.

1.2 Categories of Material

Scientific documentation may be broadly placed in two categories:

- Primary documents, such as: formal reports for external distribution, informal memoranda for local circulation, contributions to scientific journals, papers for presentation at a conference and for subsequent printed publication as Proceedings
- Secondary material, which announces the primary documents and includes: Newsletters, Bibliographies, State-of-the-art reviews, abstract lists and Bulletins

All this documentation is normally produced as a paper publication (hard copy), although formal reports are often published simultaneously in the microfiche format, especially for overseas distribution. Some material may be committed to a computerised information system and is then available in the form of computer print-out or computer microfilm as an adjunct to immediate access through a visual display terminal.

The announcement services necessary for an information centre have been thoroughly discussed by Ridler in Section 6 Volume II of this Manual.

1.3 Report Production

The production cycle for a typical research publication is outlined in Figure 1. These traditional approaches to report production are still generally applicable, although computer-aided systems, such as word processing (see paragraph 3.2.3) and computer output microfilm (see paragraph 5.5), have the potential to revolutionise some aspects of the work.

Figure 1(a) shows the stages of production for conventional offset litho printing. The manuscript may have three components (text, diagrams and photographs) which are assembled into a camera-ready master. The litho plates for text and line-work can be made directly from this camera master, but half-tones call for a screening procedure, involving the production of litho negatives in a process camera (see paragraph 3.4.2).

Figure 1(b) shows that a photocopier can be used to provide a much simpler route, which is also cheaper for small quantities because the expense of plate-making is avoided. In many cases, photocopy quality is not considered adequate for external publication, especially for half-tones (see paragraph 2.4.4), but a few photocopy systems are now able to give clean and crisp copies on plain paper that are worthy of comparison with offset litho printing.

Finally, Figure 1(c) illustrates the use of the litho camera-ready master as the master for microfilming although if there are paste-up marks and patches, it is preferable to use a clean litho-printed copy for filming.

2. PUBLICATION REQUIREMENTS

2.1 The Needs of the Reader

Any author must consider the purpose of the written material and must seek to identify the readers and their reasons for using the publication, because this will affect the language used, the structure of the material and the style of any illustrations. In a parallel way, the publishers must give thought to aspects that affect the appeal and usefulness of the document: for example, its layout, size, durability and general appearance. These factors of design, which in commercial publishing may be considered part of the marketing function, are also relevant in publications for the scientific community, where the concept of 'marketing' is not normally given great importance. Identification of the readership and the nature of the publications has several important implications.

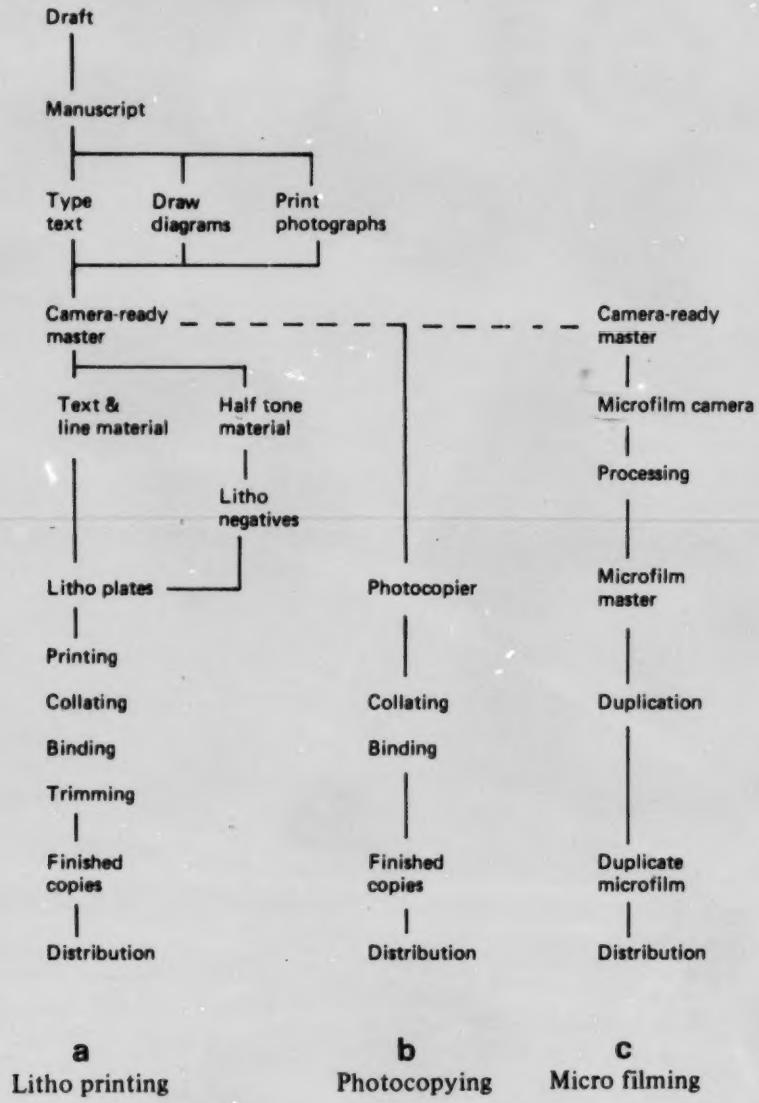


Fig.1 Stages in the production of R & D publications

In the present context, we are concerned with scientific reports and similar documentation: the readership can therefore largely be categorised as scientists, engineers, technicians and administrators working in the defence and aerospace community and their associated contractors. Given these circumstances, certain broad requirements can be identified for further discussion:

- Appearance of the documents
- Speed of publication required
- Half-tone illustrations and colour printing
- Special symbols in the text
- Security regulations for classified documents
- The volume of printing or microfilming
- The ever-present need for economy

Firstly, it is necessary to consider how the publication will be used and the most appropriate medium. It is normally assumed that scientific reports will be read in an office, laboratory or library; in which case either paper or microfilm may be equally acceptable. However, when a document is to be used at a meeting, or in a conference hall, or is read on a train journey, a microfiche is of little value. In other circumstances, of course, where quick reference is needed to single items, microfilm may be an ideal medium.

The whole process of communication, both written and visual, depends on the removal of barriers to use of the document; every publication programme must give attention to the needs of the readers, in both content and form.

2.2 Appearance

The reputation of a research organisation depends largely upon the scientific quality of its published work. The technical content of any publication is therefore the primary consideration, but the reader's acceptance of the work is always affected in some way by its appearance. This is not simply a matter of the superficial impression given by a glossy cover; it is the more fundamental question of designing the publication so that it meets the needs of the users in every way possible.

Authors commonly accept that their writing should follow certain conventions of spelling and grammar, even where these are not strictly essential to the reader's understanding. Similarly, an organisation more readily gains credibility if its publications conform to basic standards of appearance and utility. The relevant factors include:

- Cover design – the presentation of essential information (see Reference 1)
- Quality of materials – the weight and finish of paper and covers
- Method of binding – ease of opening and durability
- Evenness of typing and printing
- Quality of illustrations – clarity
- Page layout – readability
- Report structure – logical sequence and ease of reference

Most of these items imply a certain expenditure of money and effort, but the reader need look no further than this AGARD series to consider the effectiveness of a simple and consistent house style.

2.3 Speed of Publication

Most research and development work is linked to a programme that calls for the prompt distribution of the results. The frequent need for an urgent and reliable service, together with the problems of security, normally leads to the provision of printing facilities within the R & D organisation.

The requirement for a quick and simple printing process, together with the comparatively short runs required in this field of work, suggests that offset lithography or electrophotographic copying will offer the most practical solution (see paragraph 4.1).

The procurement of high-speed printing machinery does not, by itself, give a guarantee of rapid report production. The need for a short turn-round time calls for an appraisal of the whole publication cycle, from drafting the report to distribution of the finished copies. A balanced capacity is needed at all stages, which implies the provision of suitable staff as well as the appropriate equipment.

It will be recognised that speed, although important, is not the only production constraint: cost, quality and volume are other interacting factors that must be considered when the publication unit is planned. Further reviews are needed periodically to assess performance in such matters.

2.4 Half-tone Illustrations

The production of half-tone illustrations, has considerable implications in terms of equipment and staff expertise (see paragraph 3.4). Some organisations prefer to meet their occasional need for such work by making use of an external printer. The relative complexity of these procedures makes it necessary in every case to question the need for tone reproduction. There are occasions when it is essential, but in other cases line illustrations may be more effective.

2.4.1 Continuous-tone Reproduction

Conventional photographs (black and white bromide prints or colour prints) show a range of continuous tones, due to variations in the amount of silver or dye present in the image areas. Reproduction of a brightness range of 100:1 is possible on glossy papers and it is this property, together with the ability to retain fine detail, that gives the photographic process its reputation for high quality. Over-enlargement of the negative is likely to give rise to graininess, but in general the process sets the standard by which all other methods are judged. It is relatively expensive to use bromide prints for mass circulation, but they have ready application where short runs are required (see paragraph 3.4.1).

2.4.2 Half-tone Litho Reproduction

The majority of scientific reports are printed by the offset lithographic process which, like all photomechanical systems (see paragraph 4.1.3), can only produce intermediate shades of grey ('half-tones') by introducing a screen to break up the solid picture tones into dots. The dot side varies with the brightness of the subject detail and gives an impression of tonal gradation (see paragraph 3.4.2).

The consistent rendering of half-tones depends on the skill of the process camera operator and the litho printer in controlling the range of dot sizes; judgement must be exercised in relation to the requirements of individual pictures.

It is also necessary to select paper quality appropriate to the type of screen used and the standard of reproduction required. In everyday experience, the results range from the tabloid newspapers using absorbent paper and coarse screen rulings of about 70 lines per inch, to the art magazines using coated papers and a screen of 150 or 200 lines per inch. There is no point in seeking to use finer screens unless it is also decided to use art papers with a high surface finish; these will be more expensive and the need for more highly skilled staff and better equipment must also be recognised.

2.4.3 Tone Reproduction on Microfilm

Little attention is paid to tonal reproduction in many applications of microfilm. The normal procedure, whereby the master silver negative is duplicated on to diazo film, gives a negative-appearing image which is desirable for the text and line matter (see paragraph 5.1.5), but is un-natural and confusing for pictorial illustrations. In addition, most diazo films have inherently high contrast which gives a harsh tonal reproduction, lacking detail in both shadows and highlights. Some diazo films have a lower contrast and the manufacturer's advice should be sought if this is an important requirement.

It is possible to produce high quality microfilm of photographic originals (such as radiographs and spectrograms) by using silver film for both the negative and positive stages, but there are considerable penalties in time and cost. Further difficulties would arise also in the production of paper print-out from the distributed positives, because the standard bromide printing papers would give prints of negative tonality.

For most purposes, the convenience of the diazo process outweighs the need for good picture quality. The producer of microfilm reproductions of reports must bear in mind that photographic illustrations will probably be degraded to mere outlines when projected in a microfilm reader – and will be even worse on a paper print-out. This calls into question the whole issue of using photographs in reports that are to be microfilmed. In certain cases it may be preferable to prepare line drawings instead of half-tone pictures.

2.4.4 Tone Reproduction in Photocopying

The great majority of photocopiers are now based on electrophotography (see paragraph 4.5) which has the reputation of giving poor reproductions of photographs: the commonly-observed shortcomings are 'hollowed out' solid areas, a harsh jump from highlights to shadows and a grainy effect that spoils fine detail.

Some photocopying systems now give much better rendering of solid areas but, in general, the standard of tonal reproduction does not approach that of offset lithography. If this property is in any way important for a photocopying installation, a series of tests must be made, to establish the level of quality that can be achieved under normal production conditions.

Some photocopier manufacturers provide a patterned screen to lay over photographs when they are copied. This serves to break up solid areas in the pictures, but in general the half-tone quality is not improved to an extent that will be of value to the scientific reader.

2.5 Colour Reproduction

In commercial publishing, colour printing is commonly used to enhance sales appeal. In the world of scientific publication, the same marketing considerations do not apply; colour reproduction is only used if it serves a specific purpose of technical communication.

2.5.1 Line-colour Printing

The introduction of simple coloured lines into a diagram often makes a great difference to the ease of interpretation. It does not cause any major technical problems for litho-printed reports, but there are obvious economic penalties (see Figure 5) and it is to be avoided in the case of material intended for microfilming. British Standard BS 4811[1] also warns of the possible loss of differentiation in graphical information if coloured report illustrations are photocopied.

The procedure for preparing the colour artwork may differ according to the printing method in use.

(a) Direct copying in colour (using photographic colour materials, or electrostatic colour copying, or colour microfilm) calls for conventional full-colour artwork, in which all the required colours are superimposed by the graphic artist.

(b) Colour printing by offset lithography requires the printing of each coloured image in succession. If a full-colour original is drawn by the artist, colour filters and panchromatic films are used to make 'separation negatives'; a printing plate is then made from each negative.

An alternative method for line work, preferred by some printers, calls for the preparation of a separate artwork for each colour. This approach requires the artist to draw the separate images in register on a set of overlay films. Plate-making can then proceed as for black-and-white drawings, without the need for special colour-sensitised materials.

2.5.2 Half-tone Colour Printing

The need for full colour reproduction does not often arise in the fields of work covered by this Manual. However, there are occasions when good colour fidelity is essential: to show corrosion by-products, heat damage, camouflage effectiveness etc. Few Government printing units are equipped to produce high-quality colour lithography, and economic factors usually preclude the use of a commercial printing contractor – for whom the minimum run for colour work is normally measured in thousands of copies, because of the expense of colour separation work.

In cases where the quantities do not exceed a few hundred copies, a possible compromise is offered by making photographic colour prints which are mounted into the report, (see paragraph 3.4.4).

2.5.3 Colour Microfilming

Colour microfilm has been used for map reproduction, but its most popular application has been in medicine and botany, where it has proved an effective teaching aid.

Commercial colour production facilities are available from some microfilm bureaux. The setting-up charge is likely to be in the order of £70, with each microfiche copy costing a further £1. Although such rates are far in excess of black and white microfilm, they are highly competitive with those of producing a multi-page publication by colour lithography.

The small-scale production of colour microfiche, using colour film in a microfilm camera and stripping it into microfilm jackets, presents little technical difficulty. It would be time-consuming and relatively expensive to make long runs in this way, but it might be considered where a few frames of colour were vital to the understanding of a report.

Current developments in the field of colour microfilming have been reviewed by Gunn and Horder[2,3].

Despite its potentialities, the inconvenience of colour microfilm production and duplication is likely to discourage its widespread use for scientific reports. Every effort should be made to produce drawings and photographs that do not call for the use of colour (see Reference 4).

2.6 Special Symbols

It is a feature of scientific reports that they often involve the use of Greek letters and mathematical or other special symbols; the 88 characters of a standard typewriter are not sufficient for this field of work. The difficulty may be solved by the use of typewriters with interchangeable heads, or by photo-typesetters (see paragraph 3.2).

Although there are a number of technical solutions to this problem, there remains the difficulty of finding staff willing and able to set out complex mathematical or chemical work within the body of the report text. These tasks extend beyond the traditional boundaries of a typist's work and due allowance is necessary in the pay and grading structure.

2.7 Security Regulations

Classified publications are subject to control procedures to ensure that copies only reach authorised readers. Apart from the duties of the author and vetting officer, a considerable responsibility is therefore placed upon the clerical staff who progress and distribute the report material.

The security regulations may also affect the method of production in a number of minor ways:

The use of colour coding for report covers or microfiche title strips.
The numbering of individual copies of highly classified reports and microfiche.
The use of a fully secure method for binding reports.

The need for vetting of publication staff is obvious and their training in the practice of security rules is essential. A significant requirement arises in protecting partly-finished work and in handling waste paper, plates and film. Secure storage areas and the provision of shreuding or incineration equipment is a necessity for any reproduction unit.

2.8 Economy

The expense involved in producing a report can be determined without undue difficulty although its value is not easily expressed in a way that permits a cost-benefit comparison. Nevertheless, it is obviously desirable to keep the cost of publication to a minimum, and some possible areas for economy are outlined below. It is difficult, of course, to determine the point at which a reader may begin to misinterpret information, or show some other adverse reaction, as a result of cost-cutting measures. Each organisation must develop its own criteria in such matters.

2.8.1 *Materials*

Cheap paper tends to be flimsy and allows the printing to show through to the other side of the sheet; it may also have a coarse surface upon which half-tones and fine detail do not print well. Paper that has not been properly conditioned and handled may cause difficulty on the printing press or other automatic machinery.

The quality of material used for report covers plays an important part in establishing a good impression with the reader. On a more practical note, BS 4811[1] requires that "covers shall be substantial, distinctive and of sufficient strength to protect the contents for a reasonable period".

Most scientific reports are printed on paper with a substance in the range 80-100 grams per square metre (gsm). The materials used in this AGARD Manual may serve as a bench-mark for other organisations; the paper stock is 85 gsm and the covers are on 190 gsm material.

It is essential to make due provision for paper storage and to control conditions in the litho press room. As a general guide, a temperature level of 21°C and a relative humidity of 65% RH represent good working conditions for litho printing materials. If close-register colour work is required, the tolerances necessary to avoid paper stretch may be in the order of ±2°C and ±5% RH.

2.8.2 *Labour*

Staff costs are normally the largest item of expense in any publication unit and it is a major decision for management to set up a full-scale production team.

As in other fields, there are two approaches to printing production:

(a) Capital intensive, using highly skilled staff with all possible assistance from modern machinery.

(b) Labour intensive, using a high proportion of manual methods.

These extremes co-exist in some printing companies, where part-time staff are often employed for finishing operations.

An appropriate balance must be struck between the production requirements and the financial constraints, although Government units are more likely to aspire to a small and adaptable staff. However, versatility deserves to be rewarded with higher pay and the commitment to training is likely to be increased. A small team also tends to need more productive equipment, which is generally more expensive to purchase and maintain. It must be recognised that a very small unit is vulnerable to sudden machine break-down or loss of staff; it also gives less flexibility to cope with sudden surges of urgent work.

Lowly-paid staff are more likely to be unhappy, unskilled and unproductive; the labour turnover will probably be higher, with consequent gaps in production and extra training expense.

The planning of staff resources on a continuing basis is a matter for collaboration by the Personnel branch and the reprographic line management. Other aspects of staffing are discussed in Chapter 7.

2.8.3 *Equipment*

The purchase price or rental cost of equipment is readily established, but the long-term expenditure, involving maintenance charges, replacement items and breakdown costs, is less easily determined unless there is access to information from other users. In the United Kingdom, Her Majesty's Stationery Office (HMSO) is the central purchasing agency for printing and microfilm equipment and offers an impartial source of advice to those within the UK Civil Service.

Many organisations prefer to minimise running costs by investing in automatic machinery, which may require less skill on the part of the staff and should reduce handling time. It may, however, cause awkward delays when break-downs occur, because servicing is a specialised matter for the manufacturer. The guarantee of rapid attention is a vital part of the purchasing contract in such cases.

There are obvious risks in investing in a single high-capacity machine and some alternative provision must be made for continuity in an emergency.

Decisions about equipment procurement should not be based solely on historical figures for total annual demand. A more refined approach is necessary, to establish the probable peak loading (whether seasonal or randomly occurring), the effect of subsequent backlogs and the frequency of genuinely urgent requests. Occasional pressure of this sort is normally met by overtime, but if this becomes a frequent requirement it may indicate that additional resources would be cost-effective.

2.8.4 Productivity

The factors affecting productivity in printing or microfilming are much the same as in any other field of production:

Staff (motivation, supervision, training)
Environment (noise, lighting)
Materials (quality of raw materials, standard of originals for reproduction)
Equipment (safe machine speed, breakdown frequency, time spent in routine maintenance)
Organisation (work flow, interruptions)
Length of run (the time spent in make-ready)
Work quality (the standards set)

An example of photocopier output is calculated in paragraph 4.5.4 to make the point that machine speed can be a misleading basis for assumption about throughput.

3. PREPARATION OF MATERIAL FOR REPRODUCTION

3.1 Preparation of Author's Manuscript

Scientific reports are usually printed by offset lithography (see paragraph 4.6), although the letterpress process is sometimes still used where widespread public distribution is required. Photocopiers are also used for short runs (say up to 20 copies) of internal reports.

For lithography, the author's manuscript is given to a typist or photo-typesetter for preparation of 'camera-ready copy'. For letterpress printing, a compositor will set up pages of metal type. In either case, whether the final text is to be prepared by a typist or by a commercial printer, it is most important that the author sets out the manuscript clearly, with adequate instructions. Some aspects that commonly cause difficulty are:

Bad handwriting
Poorly set-out mathematical expressions
Over-crowded diagrams
Poor photographs, lacking shadow or highlight detail

The normal rules of typing for business purposes do not always apply to R & D reports, and the need for agreement on various aspects of 'house style' is discussed in paragraph 3.6.

Computer-aided publication systems are changing the preparation methods in many larger organisations, but an outline of the more conventional methods is appropriate for most scientific research establishments. The discussion therefore relates mainly to an internal printing unit using offset lithography or microfilming.

3.2 Text Preparation for Offset Lithography

The production of reports can be treated in two stages:

(a) the preparation of text matter and illustrations as 'camera ready' masters

(b) the reproduction of these masters, either as paper copies or on microfilm.

3.2.1 Equipment

The equipment currently used to prepare the text for scientific reports ranges from conventional typewriters to computer-based word processing and photo-typesetting systems. A comparison of the basic features of this range of equipment is given in Table 1.

It may be noted that typographic measurements remain largely unaffected by the general move towards metrication. Standard typewriter movements are measured in inches (e.g. 6 lines per inch vertically, 10 or 12 characters per inch horizontally). Printer's type is still measured in the traditional system of points (letter height and line spacing) and picas (width of type setting). The origins of the system are complex but, for practical purposes, a pica (0.16604 inch in the British-American system) is assumed to be 1/6 inch and a point is 1/72 inch.

8-point type (see Figure 2) is the smallest recommended size for text to be microfilmed; the upper case characters in this size are about 2.1 mm high[1].

3.2.2 Typographic features

Of the many features offered in modern typewriters and word processors, the following have significance for the preparation of R & D documents:

TABLE 1

Features of Text Preparation Equipment

Standard typewriter (type-bar design)	88 characters 10 or 12 characters per inch A few proportionally-spaced machines available Electric-impression machines available
'Single element' typewriter	Range of interchangeable heads, including scientific. 10 or 12 characters per inch (see Figure 2a-b) Standard-spaced characters only Built-in correction ribbon on some machines All-electric machines, some with external memory media (magnetic cards or tape)
Office composing machine (e.g. Varityper, IBM Composer)	Interchangeable heads from 8 point to 12 point size (see Figure 2) Proportionally spaced characters All-electric machines Some machines with internal memory store for text, or external store on cards or tape
Word processor	Interchangeable type heads, including scientific. Some machines offer proportionally spaced characters Automatic justification of print-out Internal memory for text manipulation; storage on magnetic card or diskette (floppy disc) Text display on Visual Display Unit Separate printing unit with speed of 15 cps (golf-ball) 50 cps (daisy wheel) 90 cps (IBM ink jet) Some models have twin printing wheels, to offer a wider range of symbols while maintaining high speed
Photo-typesetter	Very wide range of type styles (typically 4 different styles on-line) Range of type sizes immediately available (8 point – 48 point) Output speeds range from about 20–2000 characters per second. Proportionally spaced characters, with justification (see Figure 2e) Internal memory for text manipulation; storage on diskette (floppy disc) Output on photographic paper or film (processor needed)

(a) Electric impression

Any material typed for printing or microfilming must be clean in outline and consistent in density.

The traditional fabric ribbons do not give the crispness of the more expensive 'one time' carbon ribbons. It is important that an electric-impression typewriter is used, so that each character is struck with exactly the correct weight.

Where computer tabulations from a line printer are included in a report, care must be taken to produce a legible print-out, by attention to cleaning and regular maintenance of the printer and by running the printer at low speed. The same precautions are of course necessary in a typewriter; the most frequent single cause of illegible microfilm is the poor quality of the original typewritten input.

(b) Correction features

Every typist makes occasional mistakes; the neatness with which they are corrected is a measure of the typist's ability and is an important factor in the appearance of the finished work. Correction fluids can be adequate if used carefully, but a quicker and more effective method is offered by typewriters with a built-in 'lift off' ribbon; this removes the typed characters by simple back-spacing and over-typing.

The correction of mistakes with a word processor or photo-typesetter is effected by use of a deletion key, which erases the character from the memory at the same time that it is removed from the display screen.

The effectiveness of these correction features encourages the typist to work at good speeds, in the knowledge that the inevitable mistakes will not detract from the finished work.

(c) Proportional spacing

Conventional typewriters produce characters at a fixed spacing (see Figure 2a-b): 10 characters per inch (so-called Pica type) or 12 characters per inch (so-called Elite type) or, more rarely, 16 characters per inch (so-called Petit Roman). Because the machine advances by a standard increment, the narrow letters such as 'i' appear with more space than wider letters such as 'm'.

Traditional type-set printing is proportionally spaced, in which the space around each character is carefully designed for aesthetic reasons (see Figure 2c-d). In addition to the attractive appearance, proportionally-spaced text occupies significantly less space than standard-spaced typing. A saving of 20% in overall area may be achieved, with consequent savings in printing time and materials.

a Pica type is similar to the Pica typestyles offered as

b Prestige Elite type is a weighted type similar to the typestyles as

c Press Roman is a practical type face featuring excellent form and clarity. Characteristically, Press

d Press Roman is a unique type face highlighting both appearance and fine legibility. Characteristically, Press

The purpose of this Manual is to describe in a series of separately-published Volumes the basic documentation practices which are involved in the initial setting-up and subsequent operation of an Information-Library Organisation to provide defence-aerospace scientific and technical information services.

e

(a) Standard spacing – 10 pitch (Pica)

(b) Standard spacing – 12 pitch (Elite)

(c) Proportional spacing – IBM Press Roman 10 point

(d) Proportional spacing – IBM Press Roman 8 point

(e) Justified type-setting – IBM Univers 10 point

Fig.2 Typographic features of typewriting

(d) Justification

Since the early development of the letterpress process, printed text has been set with its left- and right-hand margins vertically aligned or 'justified' (see Figure 2e). This feature is sometimes sought by those wanting to give a good appearance to their typing. It may be achieved:

(i) simply by hyphenation of the last word in the line, which can give clumsy word breaks.

(ii) by adjusting the inter-word spacing so that each line is the same length. On conventional typewriters this requires a 'trial' typing or counting of the characters and is generally regarded as being impracticable.

Most automatic typewriters and word processors use a character and line memory; even when characters of varying width are used, these machines can adjust inter-word or inter-character spacing to achieve a chosen line length.

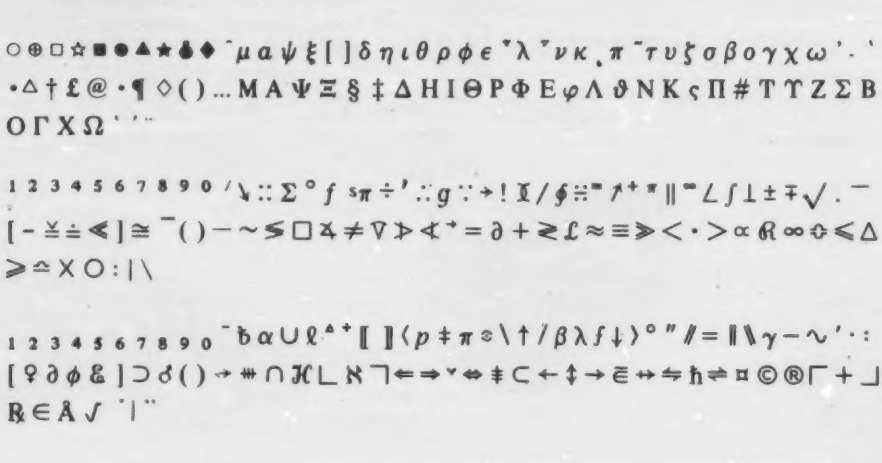
It is recommended in BS 4811[1] that the line length in unjustified text should not differ by more than 5% of the notional line length. In a typical A4 page, where a single 6-inch (150 mm) column is used with 12-pitch type, there are 72 characters per line, which suggests a permissible variation of ±4 characters. Attainment of this standard presents the typist with frequent hyphenation decisions, which interrupts the smooth flow of the work.

(e) Interchangeable heads

Conventional type-bar machines have 88 different characters, while 'daisy wheel' printers normally offer 90. This selection is adequate for commercial typing, but a range of Greek letters and mathematical symbols is essential for many scientific reports. For occasional work it is possible to use 'rub-down' lettering symbols: indeed this offers the only neat method for the typist to insert large brackets, arrows and chemical symbols such as benzene rings.

For a more extended range of symbols it is possible to fit individual 'slugs' into the typewriter, which are struck by the normal type-bar and then removed. The repeated fitting of such slugs is tedious and it is preferable to use a machine in which the complete type head can be interchanged.

(a) IBM 'golf ball' heads – Greek, Maths and Technical (10 point)



(b) Qume printer 'daisy wheel' – Greek/Maths

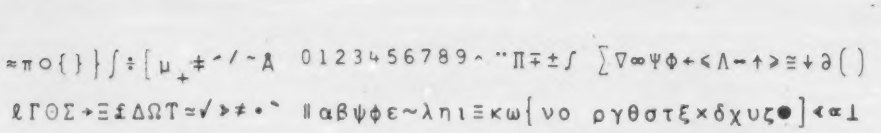


Fig.3 Technical symbols for scientific reports

The best-known systems offering interchangeable heads are the Varityper which has typing 'segments' and the IBM Selectric, which uses a spherical 'golf ball' head. Several other makers have adopted the same principle, using the term 'single element' typewriter, but the heads do not always fit other machines. A good range of symbols is offered by such systems: the IBM series of Greek, Mathematical and Technical heads offers over 200 different characters, which is sufficient for many fields of work (see Figure 3a). Additional symbols can be provided by permanent insertion of special characters in the type head.

Most word processing systems use a 'daisy wheel' printer to achieve high print-out speeds. These wheels can be changed, to offer alternative type styles and scientific symbols (see Figure 3b), although the change-over takes somewhat longer than for typewriter 'golf-ball' head.

There is considerable interest in systems that offer a wider range of characters. 'Twin track' printers are now available, featuring twin daisy wheels, so that 180 characters are available for immediate use. The value of such systems is greatly enhanced if the Visual Display Unit can show the full range of symbols, with subscript and superscript characters in the correct position on the display screen (see paragraph 3.2.3).

The IBM System 6 word processor uses an ink-jet printer capable of producing 5 different type fonts, which can be mixed as required while operating at the full speed of 90 cps.

High-speed photo-typesetters produce text by enlargement of characters from a spinning disc, or by photographic copying of a high-quality CRT display. An extensive range of type founts is available and considerable variation of letter size is possible (typically from 8 point to 48 point). The more recent photo-typesetters use Visual Display Units, with text storage on magnetic disc; many of the text-editing features of word processing are offered (see paragraph 3.2.3), plus excellent typographic quality and a wide range of symbols for mathematical work. The application of these systems to scientific and technical information is discussed by Rogers in Section 5 of this Manual. A more general reference on the subject of phototypsetting has been produced by Heath and Faux[63].

3.2.3 Word Processing and Computer-aided Text Preparation

There is now a rapid growth in the use of data processing techniques for the preparation of text. Applications range from office 'word processing' systems to large-scale 'text processing' installations which are integrated with main frame computers.

The common feature of these systems is that the text is held in a computer memory, with a visual display screen to allow rapid correction and merging with other text. When all the mistakes are corrected, the material can be printed at high speed to provide a good quality original for litho platemaking or microfilming. Alternatively, the text can be stored on magnetic media while the draft revision is undertaken; final amendments are quickly inserted through the keyboard and displayed on the screen, any desired changes to the format of the work can also be made.

The advantages are found to lie in greater productivity at the input stage, improved appearance and a more effective procedure for making changes to the drafts. Insertion of amendments does not call for total re-typing and the delay in producing the finished document or camera-ready copy is much reduced.

Figure 4 shows a number of possible word processing (WP) configurations that are applied to scientific reports. They all offer, to some degree, the same basic advantages:

- elimination of repetitive typing, reduction of errors
- freedom from some traditional typewriting constraints tends to increase the input speed
- print-out at high speed (typically 50 characters per second)
- the diskette systems give the ability to re-arrange and modify the text without difficulty, which should encourage better editing and more readable reports. Authors are largely freed from the task of manual re-writing

Table 2 outlines the production stages for text preparation and compares the features of a WP system with a conventional typewriter.

TABLE 2

Comparison of Typewriter and Word Processor

Stage of production	*Typewriter*	*Word processor*
Text entry	Keyboard	Keyboard
Error correction	Manual (eraser, correction fluid)	Automatic (back-space and strike over)
Storage of draft	Paper	Magnetic media
Revision	Re-typing or paste-in of new material	Insertion of amendments only
Final output	Re-typing (5 cps nominal speed)	Automatic error-free print-out (50 cps nominal speed)

Scientific reports differ in a number of ways from commercial correspondence, which affects the criteria for selecting WP equipment:

(a) Reports are normally lengthy and may need several stages of revision; re-structuring and manipulation of the text is a frequent requirement.

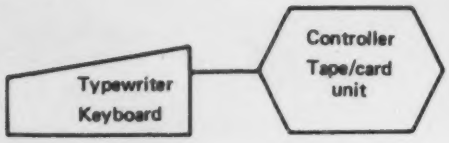
Diskettes ("floppy discs"), which may have a capacity of over 100 pages and allow rapid access to any point, offer a better storage medium for lengthy reports than magnetic cards or tape.

A Visual Display Unit (VDU) giving a page or half-page display is more useful that the single-line display offered on some office machines.

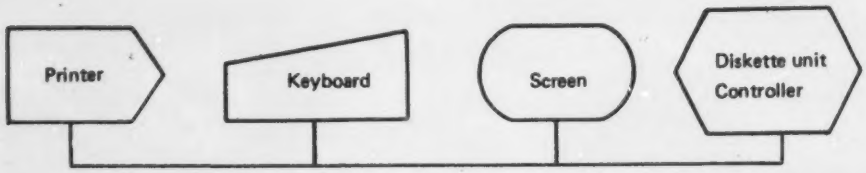
(b) In most fields of scientific research there is a need for mathematical and other symbols (see paragraph 3.2.2e). The daisy-wheel printers used for WP output can be interchanged to give additional symbols or italic letters, although this is a slower operation than the equivalent inter-change of a 'golf-ball' head on an IBM typewriter.

'Twin track' printers are available, which have two daisy-wheel heads. This allows the intermixing of standard characters with Greek and mathematical symbols without manual inter-change. A total of 192 characters can be held on-line in this way.

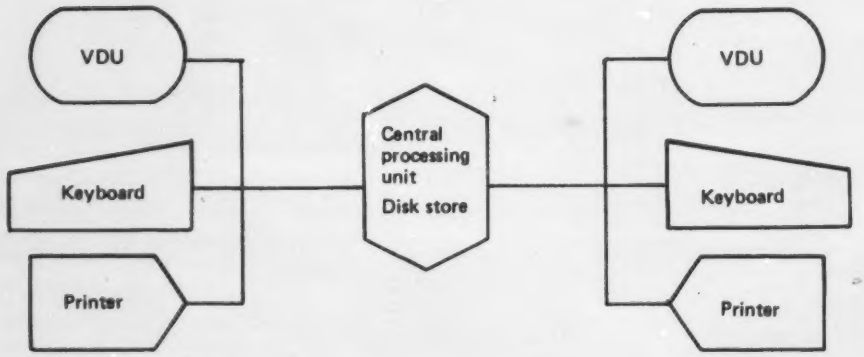
(c) The twin daisy-wheel printer offers a useful approach for scientific work, but it is important for the typist that the full range of symbols should be shown in their correct form and position on the VDU screen.



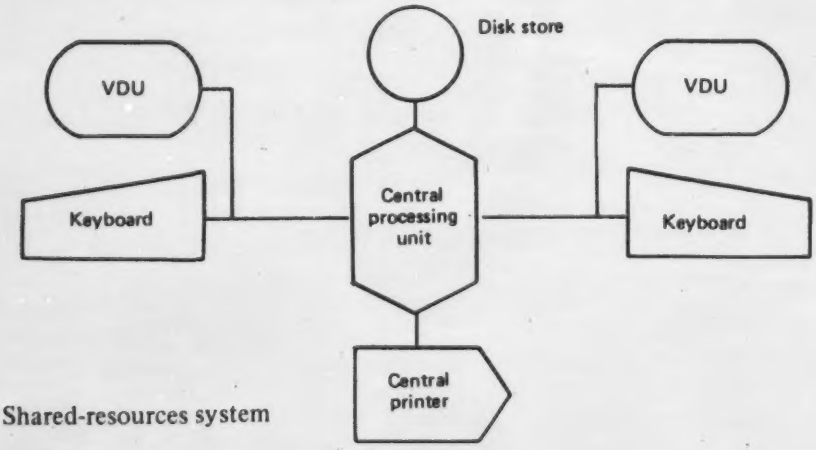
a 'Stand alone' system without screen display



b 'Stand alone' system with VDU screen



c Shared-logic system



d Shared-resources system

Fig.4 Word processing configurations

(d) The ability to interface some WP systems with a photo-typesetter offers an extremely wide range of type styles.

(e) Interface with a computer allows the computer to be used as an output printer for numerical data that is held in store following a research project. The printed quality of the WP output will be much better than the normal line printer material.

The current costs for WP equipment range from £3K – £5K for a 'non-video' system to £6K – £10K for a 'stand alone' VDU system and £10K – £100K for a shared resource facility.

Further developments of text editing in association with computers is inevitable. Berman has described several examples of computer-aided publication systems in the aerospace industry[5].

3.3 Line Illustrations

In many R & D publications, the graphs and diagrams are the most valuable part of the work. They represent visual elements that are often remembered when the written details are forgotten.

Graphical material for scientific reports may come from a number of sources:

- Hand sketches
- Professionally-prepared art work or tracings
- Illustrations copied from books, maps etc.
- Computer graphics print-out
- Oscillograms and other instrument recordings

Whatever the origins of the material, its quality critically affects the standard of the final printed matter, especially where microfilming is required. Indifferent originals are the direct cause of poor report illustrations, which in turn degenerate into illegible microfilm.

3.3.1 Line Work

It is important that lines are drawn with consistent width and weight. Only a technical drawing pen using black ink will give a guarantee of clean and consistent work, although a pencil or ball pen, if used with care, can be adequate for an informal memorandum. A smooth matte art board is preferable as a base for the drawing and it should be protected with a translucent cover sheet, upon which any instructions for scaling or annotation can be given.

Judgement of the quality of line work calls for some experience and depends to some extent upon the reproduction process to be used. In general, copying tends to increase contrast, which may serve to clean up the background, but also accentuates variations in line density.

For microfilming, where resolution is a limiting factor, a line width of 0.25 mm is the recommended minimum for reductions of 24x, with a spacing between parallel lines of not less than 0.5 mm (Ref. 4). For reductions in the range 25–50x line widths of 0.5 mm are necessary.

Most publication series can accomodate A3 illustrations as 'throw out' or 'fold out' sheets, although this depends on the binding method used. Any larger originals must be copied at reduced scale in a process camera or camer-platemaker. The size of the largest original that can be copied depends on the copy-board and the magnification range of the camera. Any such over-size drawing must be lettered in a proportionately large size, so that it remains legible after reduction[1].

3.3.2 Coloured Line Work

Many organisations are reluctant to use colour litho printing, because of the cost and the problems raised for microfilm publication (see paragraph 2.5.3), although the value of coloured diagrams sometimes overcomes the economic arguments. Any author planning to use coloured illustrations must consult the printer, to determine the preferred method of artwork preparation (see paragraph 2.5.1).

Coloured line work or 'spot' colour is much less expensive than coloured half-tone work, but it is a sensible working principle to avoid the use of colour whenever possible; differentiation can usually be achieved in monochrome by the use of dotted lines or hatching in large areas. BS 5444[4] makes recommendations for the width of hatching and shading lines.

3.3.3 Lettering for Illustrations

Titles captions and annotations can be produced in a number of ways:

typing	rub-down lettering (dry transfer)
lettering machine	stencilling
photo-typesetting	hand lettering

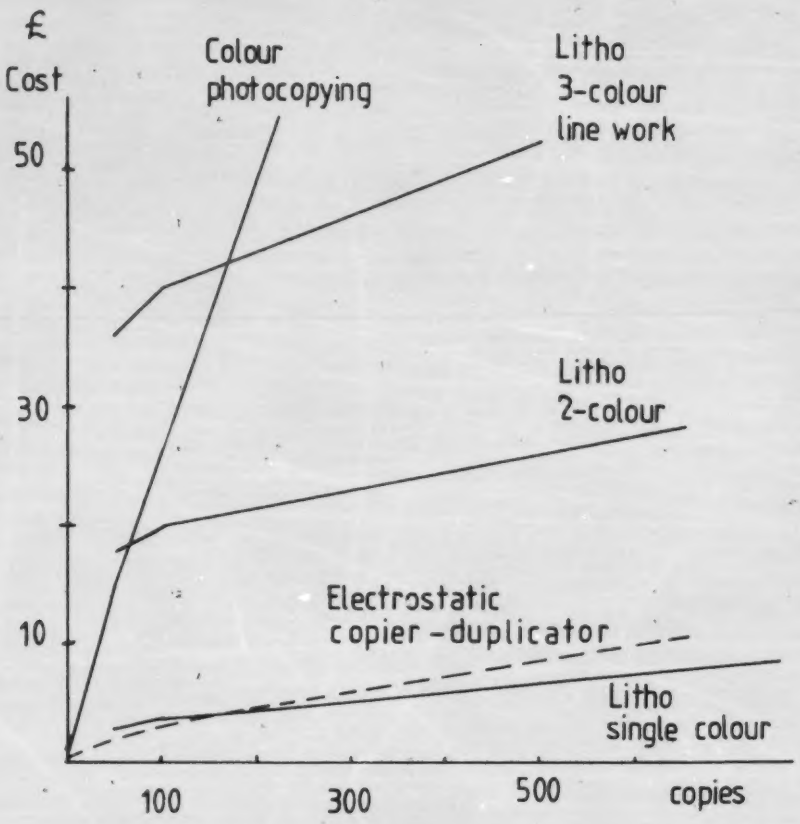


Fig.5 Line-colour reproduction – bureau costs

BS 5444 specifies a minimum height of 1.8 mm for lettering on illustrations which are to be microfilmed at 24x reduction. This dimension refers to the smallest lower-case characters, and is sometimes known as the 'x' height. Illustrations in scientific reports typically have lower case lettering about 2 mm high; the accompanying capitals and numerals will be about 3 mm high.

Plumb[6] has produced a useful work-book for those needing a better insight into the language and practice of layout and typography.

3.4 Tone Illustrations

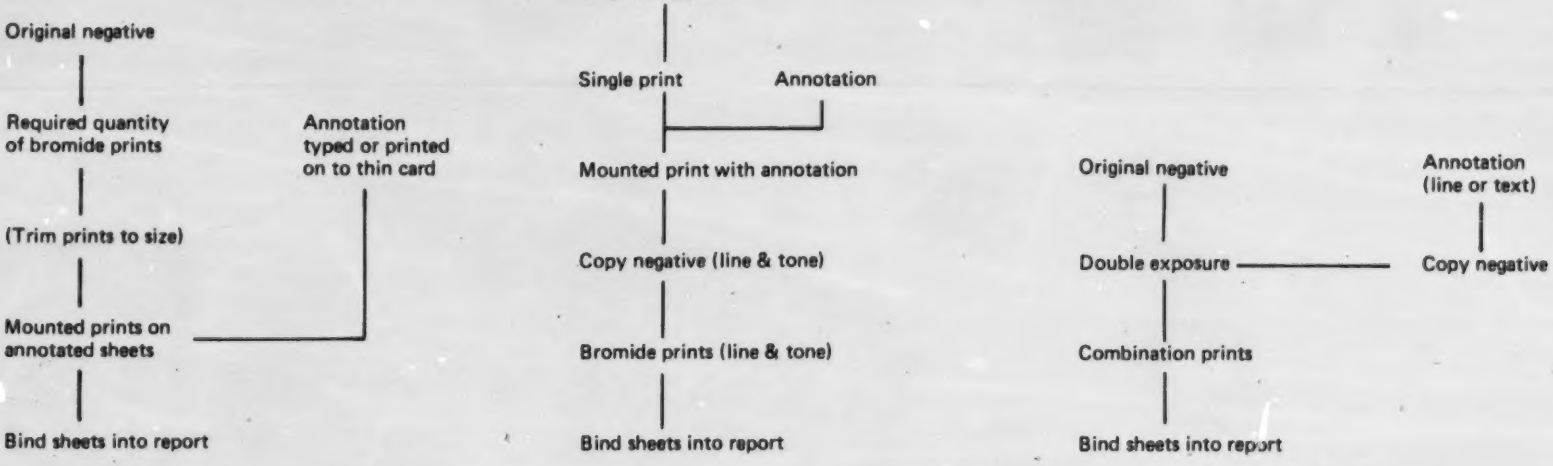
Artists illustrations and photographs (including radiographs, spectrograms etc.) present the common problem of reproducing a continuous range of tones. Conventional photographic bromide prints are used for high quality reproduction, but offset lithography is adequate for most purposes and is usually cheaper for runs in excess of 20–30 copies.

3.4.1 Bromide Prints

Where a few copies are required, it is practicable to use the procedure shown in Figure 6a. Bromide prints can be mounted on to thin card which has previously been printed with the necessary annotation and title. This method gives a high quality tonal reproduction, but calls for the individual mounting of prints and can be time-consuming for large quantities.

The method shown in Figure 6b involves the making of a separate copy negative of the annotated photograph, but avoids the need for a mounting operation and the somewhat clumsy look of mounted sheets.

Method (c) in Figure 6 avoids the quality loss of copying a continuous tone negative and the need to mount the final prints, but the printing stage is rather laborious and requires two enlargers used in succession for exposure of the tone and line negatives.



a Mounted bromide prints

b Composite line-and-tone negative

c Double-exposure printing

Fig.6 Use of bromide prints for illustration

An example of the relative costs of these methods is shown in Figure 7 using arbitrary cost units. For small quantities (up to about 15-off in this example) method (a) is the cheapest, but for longer runs the time taken to mount prints outweighs the time needed to make a copy negative; method (b) then becomes somewhat cheaper.

Figure 7 also shows in a general way the pattern of cost associated with the printing of half-tones. In this example, the economic break-even point is shown to be around 20 copies; longer runs would be more cheaply produced by offset lithography. The economic factors and staff resources will differ considerably in various printing units, so the break-even point requires detailed calculation and balancing against the quality of reproduction that can be produced. 'Break even' points of this nature are necessary background knowledge for the publication management team, but they must be applied with discretion in the ever-changing situation of daily production.

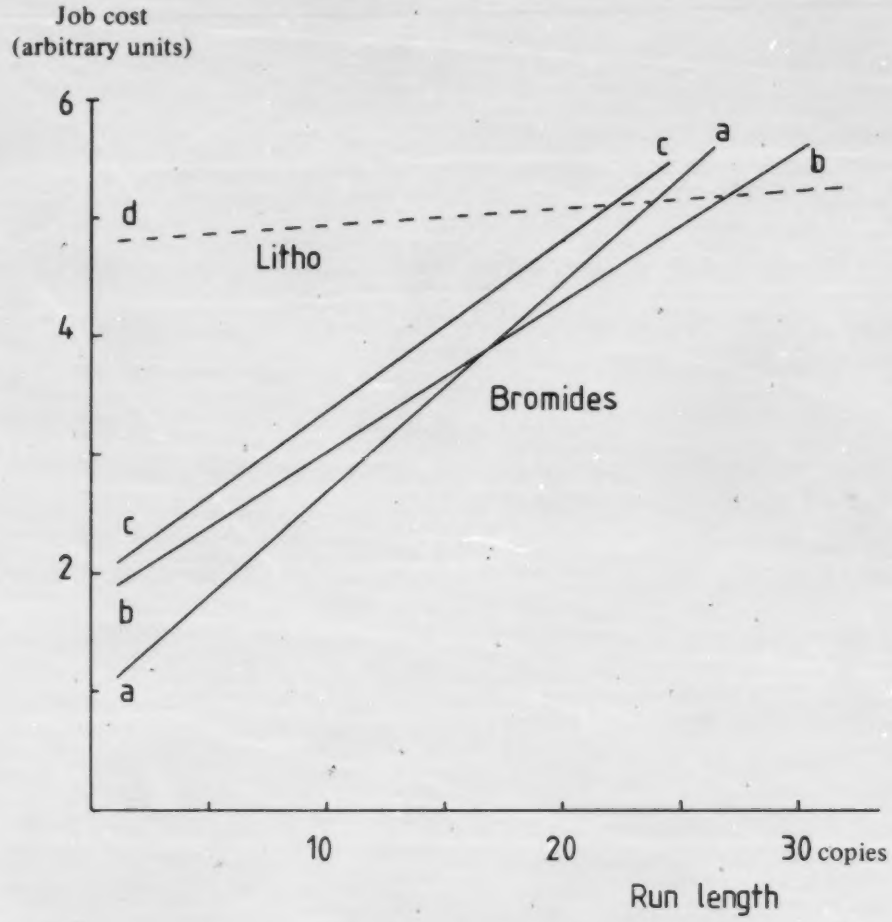


Fig.7 Production of illustrations – cost of bromide prints and offset litho half-tone prints

3.4.2 Screening of Continuous-tone Originals

In order to reproduce continuous-tone originals by the lithographic process, it is necessary to use a half-tone screening technique. The tones are converted by use of a contact screen to a dot pattern, with variations of dot size giving the impression of tonal gradation. In dark areas the printed dots are large and almost merge into a solid; in the lightest areas the printed dots are small – but if they are allowed to 'drop out' completely, the highlights have a blank, washed-out appearance. In practice, the range of dot sizes is controlled to run from 5% to 95%, in order to convey a smooth tonal gradation from white to black.

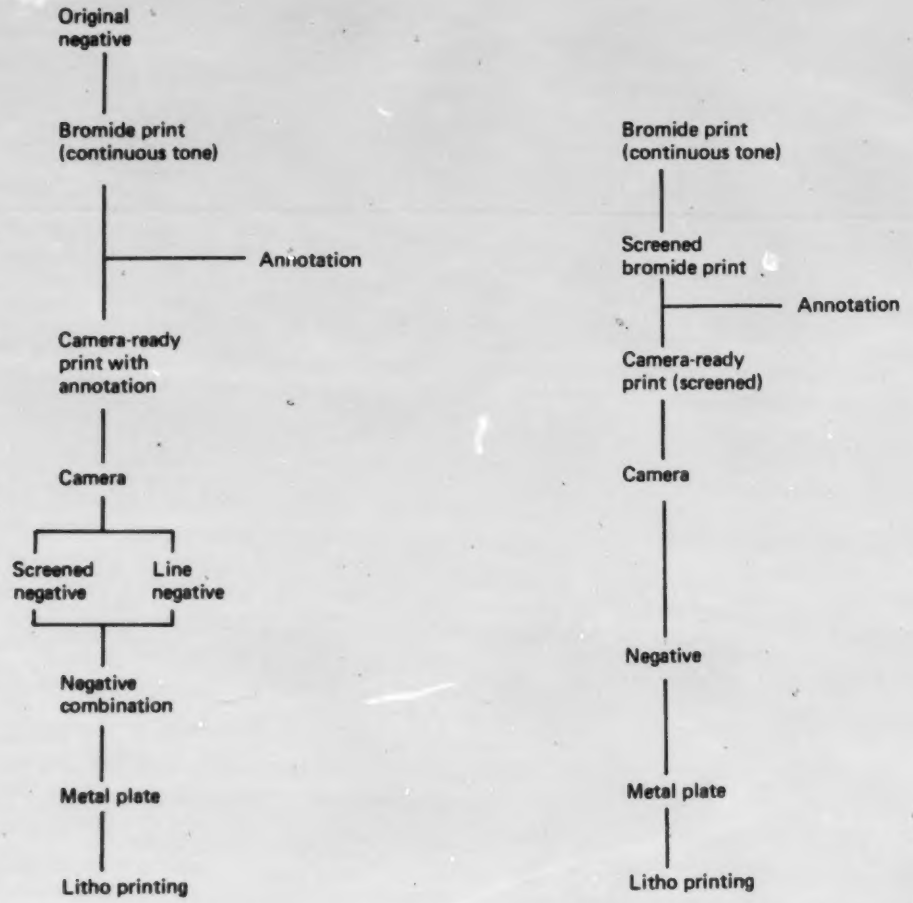
Photographic illustrations are usually associated with text or line work, which calls for the combination of screened and line elements. The two most common methods are:

(a) assembly of screened and line negatives (see Figure 8a)

(b) 'paste up' of screened prints and line matter in paper form (see Figure 8b).

The first method is more common, although it is confined to relatively simple picture layouts that can be cut into the film negatives. It allows the use of finer screen rulings, which gives a better tonal quality where glossy papers are to

be used. Where this method is adopted, authors are sometimes asked not to mix half-tone illustrations and text matter on a single page.



a Assembly of screened and line negatives

b Paste-up of screened prints with line and text matter

Fig.8 Production methods for half-tone illustrations

The second approach offers greater flexibility because the paper prints can be easily cut and pasted into pages of text; arrows and other annotation can be overlaid on the screened half-tone areas. A single litho negative is made from the 'paste up' camera copy, which contains both line and screened material. Some dot losses arise in the copying of the screened bromide print but, with care, screen rulings up to about 100 lines per inch can be used, to give good tone separation with the great majority of subjects.

3.4.3 Pre-screened Material

It is sometimes necessary for an author to use an illustration from another printed publication. Such pictures will already have been screened and if they are copied through a half-tone screen, an unpleasant moiré effect will be produced, due to interference between the two screen patterns. The remedy is to omit the screen at the copying stage, treating the entire original as a line subject and seeking to record all the half-tone dots at their correct size. This 'dot for dot' technique requires some skill by the process camera operator, but in general a satisfactory litho reproduction can be made from most illustrations in newspapers and scientific journals.

Contributors to the proceedings of scientific conferences are sometimes asked to provide their photographic illustrations in the form of screened bromide prints; a screen ruling of 80 or 100 lines per inch is sometimes specified. This greatly simplifies the task of the publication staff, who can then produce litho negatives without the need for screening and combining negatives, (see Figure 8b).

3.4.4 Colour Photographs

As discussed in paragraph 2.4.2 one practical method of including colour pictures into a report is to mount the prints on to the printed litho page. As with bromide prints (see paragraph 3.4.1), this is not a particularly convenient process, but it can give high quality colour reproduction from colour negatives or transparencies. For runs of tens or hundreds of copies the cost can be a fraction of colour lithographic printing.

3.4.5 Presentation of Photographs

Authors may supply the printer with negatives for the production of the final camera-ready illustrations, but in many cases they will provide finished prints ready to be laid down for copying. There is no need to reduce or enhance the print contrast, the prints should meet the normal criteria for a good photographic representation.

It is important that prints for copying are not marked in any way; they should not be fastened with paper clips and there should be no writing on the back, because of the risk of identation showing on the front of the print. Camera-ready prints must be kept flat and not rolled; preferably they should be mounted on to board, with a protective flap of translucent paper to keep the print surface clean. Any instructions for cropping, arrowing or annotations should be pencilled lightly on the overlay sheet. Other details are best written in the clear margin of the mounting board; it is important that the job title or number should be identified on each original.

3.5 Camera Copy for Microfilm

The requirements for microfilm camera copy are specified in BS 5444[4]. which covers aspects such as type-style, line width, character size and the placing of illustrations on the microfiche.

It is possible to microfilm either:

(a) the 'camera-ready' masters that are used for litho plate-making

(b) a selected litho-printed copy

The latter is generally preferred because it contains no 'pasted-up' material and thus gives no shadow lines; any photographs may also benefit slightly from the half-tone screening.

BS 5444 also recommends that any marked or creased original should be copied before filming, in order to provide a clean master for microcopying. It also suggests that the material should be re-examined for possible editing and re-structuring to suit the needs of the microfilm user; for example, illustrations should be placed in adjacent frames to the relevant text and should be repeated if necessary throughout the microfilm sequence.

3.6 House Style

There is usually no desire to impose a standardised style of writing for scientific reports. but it is preferable to achieve uniformity in the manner of presentation. It saves uncertainty on the part of authors, typists and printers if some form of standard instruction is provided:

(a) Guidance to authors on the preparation of drafts and manuscripts

(b) Guidance to typists and other key-board operators preparing camera-ready copy.

3.6.1 Reports

R & D establishments usually give their authors guidance in a number of respects:

- Structure – sequence of presentation
- Details required for the cover and documentation page, length of summary
- Use of illustrations – methods for preparation of diagrams
- Security requirements
- Advice on distribution lists
- Vetting procedure
- Guidance on spelling and abbreviations
- List of symbols available for the reports
- Presentation of mathematical work and chemical symbology
- Presentation of references

It is preferable to present this guidance in the specified report format, to give a concrete example of the method of presentation.

3.6.2 Conference Papers

When conference speakers are asked to provide camera-ready copy for publication in the proceedings, they are normally given guidance for their typists:

- Margins, column width, line spacing, paragraph spacing
- Manner of setting out the title and author's name
- Style of headings, position of page number
- Size of type (e.g. 12 pitch Elite)
- Any restrictions on the use of illustrations
- The need to use an electric typewriter and ink drawings.

Many conference committees provide authors with layout sheets upon which the typed contribution must appear. These are printed in non-reproducing blue ink, so that the typist has a frame to work in and uniformity of margins is ensured.

3.6.3 Preparation Standards

Commercial publishers and printers often produce their own instructions for authors, but a general source of advice is offered by BS 5261[7] which, though related mainly to type-set publications, contains much of relevance where camera copy is produced by the typewriter (see also Reference 8). The standardisation of instructions to printers is further aided by BS 5261: Part 2, which specifies the marks to be used when correcting proofs.

Organisations wishing to prepare their own guidance on house style will find a useful basis in BS 4811[1] and ANSI Z39.18[9]. Further background on the preparation of scientific papers is given in ANSI Z39.16[10].

BS 5444[4] points to the special need for the preparation and editing of documents that are being converted to microfilm.

4. REPROGRAPHY

The purpose of this chapter is to outline the processes that are used for the production of R & D publications. The operating principles have been covered in detail by Hampshire (see Bibliography), but it is hoped here to indicate some of the factors affecting process selection (see also Reference 11). The readers of this Manual will recognise that this outline will by no means make anyone a technical expert, but it may offer a basis upon which further discussion with reprographic staff can build an understanding of the practical details involved.

4.1 Photocopying, Duplicating and Printing

4.1.1 Photocopying

The original photocopying processes were based on the silver halide materials, using the 'reflex' principle of contact copying, or the Kodak Photostat camera system. In the special case of engineering drawings and other translucent originals, the blue-print process was used – although this is now displaced by diazo (dyeline) papers. Diazo paper can still offer economic advantages for office systems using translucent originals, but most photocopying systems are now based on the electrophotographic process (see paragraph 4.5).

The term 'photocopying' or 'convenience copying' implies the production of a few copies, where the primary concern is with the speed of production and economy. The results must obviously be readable, but the niceties of appearance are not of importance.

4.1.2 Duplicating

The term 'copying' usually refers to making a small number of copies from documents not especially prepared for reproduction. 'Duplicating' implies a relatively long run for which typed or graphical material has been specially prepared. There are four processes to which the term is commonly applied:

- Stencil duplicating process (see paragraph 4.3)
- Spirit duplicating process (see paragraph 4.4)
- Electrophotographic process (see paragraph 4.5)
- Offset lithographic process (see paragraph 4.6).

The distinction between copying (short runs) and duplicating (longer runs) is becoming somewhat blurred, with the advent of high-volume copying systems capable of competing in quantitative and qualitative terms with some traditional processes; these systems are generally termed copier/duplicators to denote their versatility.

4.1.3 Printing

The principles of the traditional printing processes are shown in Figure 9:

(a) In offset lithography the ink image is transferred from the printing plate, via a rubber blanket, to the paper or card material. The formation of the oleophilic (ink-receptive) areas is described in paragraph 4.6. (Planigraphic printing).

(b) The letterpress process uses a raised printing surface, prepared by etching a printing 'block' or by the assembly of metal type. (Relief printing)

(c) In the photogravure process the image is formed by etching into a copper surface; the ink is carried in the shallow image 'cells' (Intaglio printing)

(d) Screen printing uses a stencil film carried on a fine-mesh screen (silk, nylon or metal). ink is forced through the stencil on to the paper. This process should not be confused with the use of an optical screen to make half-tone negatives (see paragraph 2.4.2).

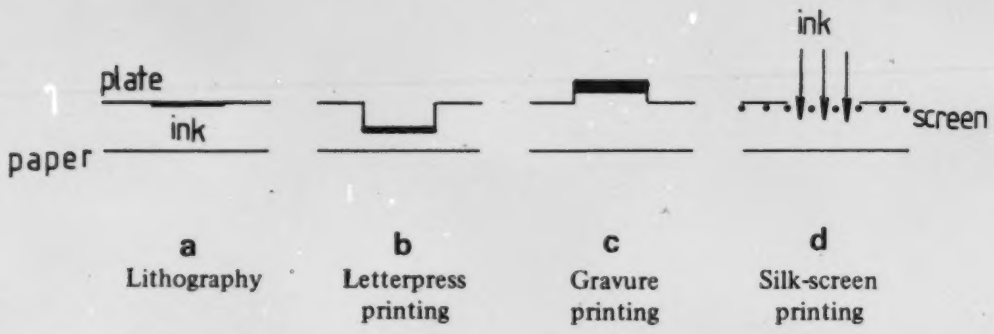


Fig.9 Principles of the major printing processes

Several other methods of printing are in use, ranging from the 'strike-on' methods of typewriters and computer line printers, to the newer 'non-impact' systems such as ink-jet and laser printers. In the context of this Manual, interest centres on the offset litho process (see paragraph 4.6) although, for prestige purposes, report covers are sometimes screen-printed. Organisations without internal resources may send their work to an outside printer who, for the longer runs, may decide that the letterpress process is more appropriate economically than offset litho printing.

4.1.4 Summary

The terminology of 'photocopying', 'duplicating' and 'printing' may be summarised as follows

Photocopying:	The making of a few copies (say 1–10 off) from a wide range of originals, where quality is less important than speed. Photocopiers are simple to use, requiring only a few minutes training.
Duplicating:	The production of longer runs (say 10–100 off), usually from specially-prepared originals. The increased volume implies a wider readership and quality assumes greater significance. To achieve trouble-free output, thorough training of the operators is needed.
Printing:	In the present context, 'printing' implies the traditional ink-based processes shown in Figure 9, which are all suitable for long runs of high quality work. A 'printer' is a skilled craftsman with several years of experience.

Some economic aspects of short-run reproduction are mentioned in paragraph 5.2.4.

4.2 Reprographic Processes

A useful source of information on the operating principles of current processes is provided by Hampshire (see Bibliography). A summary showing applications of four main processes is given in Table 3; some new materials developed for microfilm applications are mentioned in paragraph 5.3.4.

4.3 Stencil Duplicating

For the purpose of this Manual the reproduction processes of major interest are electrophotography and offset lithography. It is appropriate to mention stencil duplicating, which is still in use for short run work. although BS 4811[1] specifically warns against the unskilled use of stencil or spirit duplicators.

The stencil is cut by typing or drawing on a sheet of vellum, known as a 'skin'; this is fitted to a rotary machine in which ink is forced through the stencil on to the paper. Duplicating paper needs to have a certain absorbency and has a characteristic rough surface which detracts from its appearance.

Stencil duplicating has, perhaps unfairly, a reputation for being a messy process and it has lost ground in recent years as a major office reproduction medium. In its basic form it can only handle simple diagrams that can be cut manually into the stencil. However, electronic scanners can now be used to cut stencils from any existing text or line material.

The reproduction of continuous-tone photographs is also possible with a scanner, although the quality is not likely to be entirely satisfactory for the production of R & D publications.

TABLE 3

Applications of Reprographic Processes

Process	*Application*			
	Photocopying	*Printing & duplicating*	*Microfilm*	*Other*
Silver halide	Virtually obsolete except for specialised work such as map and drawing reproduction	Litho negatives Some plate-making materials	Virtually all camera materials (but see paragraph 5.3.4) Some microfilm print-out	Photographic films Bromide prints Photo-typesetting
Diazo	Engineering drawings Some document copying systems	Some litho plates	Widely used for duplicate microfilm (also the related vesicular process)	Overhead projection transparencies (OHPs)
Thermography	Limited to low volume copying	Some stencil duplicating masters	(Some silver halide materials are developed by heat)	OHPs
Electrophotography	The dominant copying process (Now competing directly with offset litho duplicating)	Some litho plates	Microfilm print-out	OHPs

4.4 Spirit Duplicating

Spirit duplicating (also known as the hectographic process) is cheap and suitable for short runs where the highest quality is not needed. It is probably not used anywhere for scientific reports, its current application is confined to address labelling and other business systems although it is popular in schools, where many spirit duplicators are still to be found.

The spirit masters are prepared by typing or drawing on to an art-surfaced paper which is contact with a transfer sheet bearing a dye. The dye is thus transferred by pressure to the back of the master sheet, which is then fitted to a rotary spirit duplicator. The printing paper is moistened with spirit and is pressed against the master, picking up a dye image; the printed image gets weaker as the dye on the master gets used up.

Transfer sheets are available in seven colours, including the purple dye which is most commonly associated with this process. Masters can be prepared in several colours by successive contact with different transfer sheets. Despite its relative decline, the spirit process still offers short runs of multi-colour line work more cheaply than any other method.

4.5 Electrophotography

4.5.1 Background

Following the development of Carlson's original process (1942), the Xerox Corporation dominated the commercial photocopying market to the extent that the terms 'Xerox copy' and 'photocopy' became almost synonymous in popular language. This obscures the fact that there are now many other suppliers and variations of the process and the generic term 'electrophotography' is to be preferred. The development of the process has been discussed by Lehmbeck[12]

The original xerographic process formed an electrostatic image on a charged selenium drum; the drum was cascaded with a toner powder, which adhered to the image area; the powder was then transferred to plain paper or another support and fused on to the surface. For many years, because of the Xerox patents, competing companies were obliged to use an alternative method, whereby the pigment image was formed and fused directly on to a coated zinc oxide photoconductive paper.

A general distinction thus arose between 'plain paper copiers' (marketed by Xerox) and 'coated paper copiers' (offered by all competing suppliers). However, the market has now broadened; other companies now offer plain paper copiers and improved coated papers have also been developed.

Despite some consumer reaction against heavily coated papers, they offer a useful feature for offset lithography. The pigment image is oleophilic (ink-receptive) while, if the sheet is treated with a conversion fluid, the background coating can be rendered hydrophilic (water-receptive). These are the necessary properties for an offset litho plate (see paragraph 4.6.4) and such copies can be used successfully as 'short run' offset litho masters. Machines of this type can thus be used in a dual role: as a photocopier for small numbers of copies and as a platemaker for longer runs by the litho process. When used as a litho plate, runs of several hundred copies are possible from a master costing only a few pence.

4.5.2 Electrophotographic copiers

Virtually all photocopiers now operate on the electrophotographic principle, although there are variations in the methods of toning and fusing that can give significant differences in the copies, particularly in the rendering of solid areas and half-tones. The quality of most photocopies does not meet the critical standards of external report publication. There is often a certain lack of crispness in the image and a dirty background which may indicate the need for effective cleaning. The process is, however, widely accepted for all internal publications and increasingly, as improvements are made, it approaches the standard expected for external circulation. In such cases, it is perhaps only in respect of half-tone illustrations that the process falls short of the technical requirements of scientific authors.

The photocopier market is too large to permit a full survey here, but it is appropriate to list features that may be relevant to the production of reports, although it will be difficult to find a machine with all these desirable characteristics:

- Document feeders, to work through a stack of originals automatically in sequence
- Reduction copying from A3 to A4 size, which is useful for reducing computer print-out to the standard report format
- Same-size A3 copying, which is useful for including over-size drawings or tables that are too complex to withstand reduction in size
- Double-sided copying, to reduce the bulk of the finished document
- 'Computer control', which adjusts the charging and toning levels to give consistent print quality, and assists the operator with immediate diagnosis of faults
- On-line sorters, to automatically put the work into sets as the copies are printed (see Figure 10).

There are over 100 photocopiers on the UK market and selection is not a simple choice between a plain paper and a coated paper system, or between renting and purchase, or between high and low volume – although all these factors have to be considered. For R & D publications, as in any other field, the criteria of copy quality, operating capacity and convenience must be applied critically to the competing systems. The total cost, which will include materials and machine maintenance as well as meterage and rental charges or capital costs, must be evaluated carefully. The price structure may be complex, and the most economical choice can be affected greatly by the nature of the work; the monthly volume and the mixture of run length are particularly important factors.

Plain paper is considerably cheaper than coated photocopying paper, but the former machines tend to be more expensive. This leads to a situation where coated paper machines are cheaper for small volume users, but it may be more economical to change to a plain paper system for high volume work.

4.5.3 Electrophotographic Microprinters

Virtually all microform print-out systems are based on electrophotography (see paragraph 5.4.7). In most cases these use coated paper, but exceptions are the Canon and Xerox machines, which print on to plain paper, card or film materials.

A useful feature on many electrostatic printers is the ability to select the polarity mode, so that positive prints may be made from either positive or negative-appearing microfilm.

A full survey of reader-printers on the UK market is published by Baker[13].

4.5.4 Photocopier Output

Photocopy manufacturers normally quote their machine capacity in terms of the number of copies that can be produced per minute. This can give rather a false picture where the machines are used for short runs. As an example, we may take the case of a high-speed photocopier with a speed of 60 copies per minute (although some faster machines can now produce 120 copies per minute):

(1) The time taken for the machine to produce the first copy of any original is likely to be about 8 seconds (down to 5 seconds on some new machines)

(2) The full running speed (one copy per second) will only be achieved for the second and subsequent copies.

(3) The time taken by the operator to read and understand the request, insert the original into the copier and press the control button will be in the order of 5 seconds. A similar period may well be needed to pick up the finished copies and dispose of the job, so the total 'make ready' or 'job handling' time is likely to be about 10 seconds as a minimum.

From the figures in Table 4 it appears that with short runs the output will inevitably fall far short of the quoted machine capacity. With orders for '3 copies off', no more than 3 jobs could be done in a minute; with this pattern of work it would take almost a full day to produce the 3600 copies that are nominally an hour's work for this copier. It is not suggested that a single operator would sustain this intensive, repetitive work load for a full day, some form of shift system would be appropriate and an assistant might also be partly occupied in sorting, stapling and despatching this work.

Automatic document feeders and on-line sorters serve to improve document flow and can bring useful economic benefits by reducing the paper-handling time.

TABLE 4

Photocopier Output – A Worked Example
(assuming a high-speed copier with a rated output of 60 copies per minute)

	1 off	*3 off*	*10 off*
Make-ready time per job	10 seconds	10 seconds	10 seconds
First copy	8	8	8
Subsequent copies (1 per sec)	–	2	9
Total job time	18 seconds (3.3 jobs/minute)	20 seconds (3 jobs/minute)	27 seconds (2.2 jobs/minute)
Output per minute	3.3 copies (3.3 jobs x 1 off)	9 copies (3 jobs x 3 off)	22 copies (2.2 jobs x 10 off)
Output per hour	200 copies	540 copies	1320 copies
Output per 7 hour day*	1400 copies (1400 orders)	3640 copies (1213 orders)	9240 copies (924 orders)

* In a standard working day, the time for routine maintenance, machine warm-up and operator breaks will occupy a significant period. The amount of 'lost' time varies to some extent with the process, but 50–60 minutes is not untypical.

Similar factors affect almost every machine-aided process; theoretical speeds can paint a grossly optimistic picture of potential output. In many cases, attempts to sustain the maximum speed simple leads to increased breakdown.

4.6 Offset Lithography

4.6.1 Background

Senefelder's original process (1798) used a limestone surface, upon which the image was drawn in greasy ink. The surface was then 'etched' with an acidified gum solution, which entered the grain of the stone, 'de-sensitised' its affinity for ink and made it water-receptive (hydrophilic). For printing, the stone was dampened and ink was rolled over the entire surface, adhering to the image areas, but being repelled by the dampened background areas. The ink image was then transferred by contact on to a sheet of paper and the sequence of damping, inking and image transfer could be repeated as required.

The original process is used to produce fine-art lithographs, but in most commercial applications the stone surface has been replaced by flexible plates which are fitted to rotary presses for high-speed reproduction.

4.6.2 The Offset Process

The original lithographic process was based on the transfer of the inked image directly from the plate surface to the paper, but the need to maintain good contact between plate and paper brings the risk of abrading the image. The principle of offset printing is therefore employed, in which the ink image is transferred firstly to a rubber blanket and then printed or 'offset' on to the paper or card stock.

This method also gives a plate that reads correctly, whereas the plates for direct lithography had to be prepared in mirror-image form in order to give a correct-reading print.

The phrase 'small offset' is often used to describe litho printing presses of A4 and A3 size, to distinguish them from the A2 and larger sizes used in the printing industry.

There are several types of litho plate in current use, including the 'direct image' plates for which a greasy ink ribbon is used to type directly on to a paper plate. The two processes of immediate interest are the 'pre-sensitised' metal plates for longer runs and half-tones, and the plastic or paper plates for short runs with maximum economy.

4.6.3 Metal Plates

Originally, the metal plate was coated with a UV-sensitive dichromated colloid immediately prior to use; it was then dried and exposed by contact with a line or screen litho negative. The current pre-sensitised plates use diazo or photopolymer compounds which have a much better shelf life and are ready for immediate use. Exposure to UV radiation hardens the coating in image areas and the plate is then 'developed' by dissolving away the unexposed coating. This uncovers the grained metal surface which, after etching, is water-receptive; the exposed and hardened coating is ink-receptive but rejects water, so the litho printing sequence of plate damping, inking and image transfer can take place on the litho press.

Metal plates have a surface and image quality which is ideal for half-tone work and also have the strength to permit the printing of many tens of thousands of copies. A somewhat cheaper version is offered by metal foil plates, which have an aluminium layer on a plasticised support. The limited strength of the support makes the foil plates unsuitable for re-use, but the surface is capable of giving good half-tones and running several thousand copies if required.

In their traditional form, metal plates are prepared by contact exposure through a line or screen negative. A useful variant, with less expensive equipment, is offered by chemical transfer plates which can be produced on metal, plastic or paper supports.

Some electrostatic platemakers can use metal-based materials, which offers the advantage of a robust plate which can be produced quickly without the need for a wet process.

Systems using light-sensitive coatings were originally termed 'photo-lithographic' to distinguish them from the manually produced images of pure lithography. The 'photo' prefix is now often omitted, because in the commercial context there is little chance of confusion with true lithographic materials.

4.6.4 Plastic and Paper Plates

Metal and foil plates, although capable of high quality work, are expensive; the need for photographic negatives also brings disadvantages in terms of facilities and staff expertise. There is therefore considerable interest in alternative processes that produce a litho plate directly from the original, without the need to make an intermediate negative. Such systems are generally described as 'photo-direct'; some are based on variations of the silver halide process, others use the principle of electrophotography and offer the advantage of operating without the need for drains or water supplies.

Plates may be made by contact printing or in a platemaker-camera, which permits variation of image size and may allow the use of a screen to permit half-tone reproduction. The degree of half-tone control generally falls short, however, of that offered by the traditional negative/metal plate process and the photographic reproduction quality must be critically compared to the standards required by the publishing organisation.

For the lowest cost, electrophotographic copiers (see paragraph 4.5.1) may be used to make litho masters, either on zinc oxide-coated photocopy paper or on a stronger plasticised support. Such plates are ideal for automated litho systems, where quantities in the order of 10–100 copies are needed, although runs up to 1000 copies are possible, depending on the support material. The plates cannot be re-used and will not give satisfactory half-tones, but well-prepared text and line originals will give results of sufficiently good quality for the great majority of purposes.

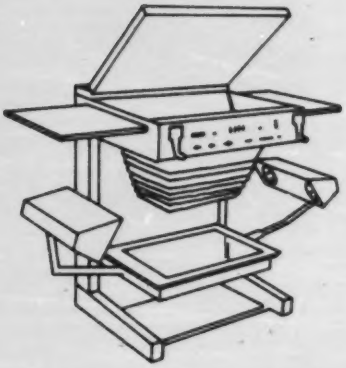
The economic 'break even' point between photocopying and offset lithography is a subject of considerable competition between system suppliers. It is not possible to make a general statement; different printing units may find their economical and practical break-even point to be anywhere between 10 off and 50 off, with the litho process more suited to the longer runs.

4.6.5 Litho Machines

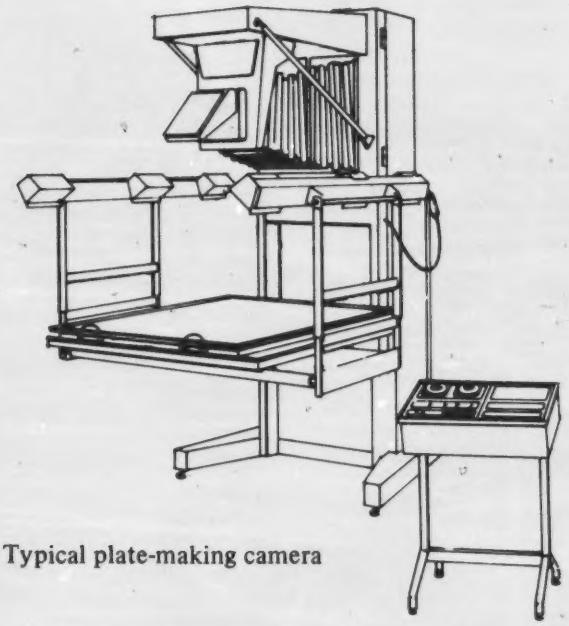
In the field of small offset printing, litho machines may be placed in the following categories:

- Simple table-top machines
- Conventional floor-standing machines
- Programmed machines, with auto plate-feeding, copy counting and blanket cleaning
- Integrated systems machines, with on-line plate-maker and paper sorter.

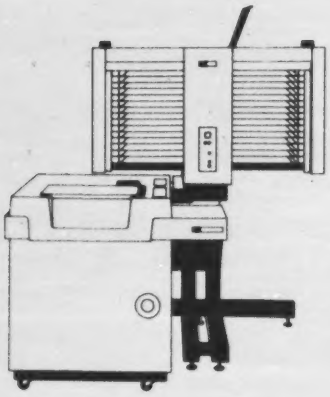
In the world of large-scale commercial printing, other developments include web-offset printing (instead of the normal sheet-fed presses) and multi-colour machines. In recent years, 'perfecting' presses have been introduced to the



a Process camera (Agfa Repromaster)



b Typical plate-making camera



c Electrophotographic copier with sorter (Oce Skycopy)

Fig. 10 Reprographic equipment

field of small offset printing; these machines are fitted with two printing plates and print both sides of the paper at a single pass through the machine.

Given that good plates have been made, successful litho printing depends on the maintenance of balance between the ink and water reaching the plate, and the continued monitoring of the work quality as it is delivered from the impression cylinder. A trained operator will obtain good results quickly and reliably, but for an inexperienced person the number of variables in machine setting, ink and paper condition is such that difficulties soon arise.

The selection of a litho press requires considerable technical experience and a clear understanding of the nature of the work. The need for half-tones, large solid areas, close-register work and the ease of machine adjustment are more important for some categories of work than the utmost speed of output.

4.7 Finishing

Before the finishing stages can commence, the inked image must be dry enough to withstand smudging and set-off from one sheet to another. The time required for drying depends on the type of ink, the paper surface and, to some extent, on the atmospheric conditions. The materials used for high-volume litho systems are chosen for quick drying, so that the pages can be collated straight from the press. In other cases, where large areas are printed with considerable weight of ink to give good half-tones or solid areas, over-night drying may be necessary, especially if an art-surface paper is used. In such cases the needs of speed and high quality are incompatible.

4.7.1 Checking

Prior to collation, it is necessary to check the material for printing quality (even inking, clean background, crisp outlines, good solid areas) and completeness (no missing pages, all pages correctly backed-up in printing).

This is the last stage at which inspection of the report is practicable and, in some cases, it may be felt appropriate to assemble a complete copy for the author to approve, prior to binding. It is, however, too late for any change of mind about the text or other detail of the content; many organisations do not offer a checking option to the author at this stage.

4.7.2 Collating

All the required copies must be assembled into order before binding, trimming or any other finishing operation. This may be assisted by collating machinery, although a practised operator can gather small jobs by hand as quickly as a machine.

Semi-automatic collators are useful for jobs up to about 16 sheets per set. The operator is presented with the top sheet of each printed stack, so that a complete set can be collected with a single movement of the hand across the front of the machine.

Automatic collators are available with up to 36 or 50 bins; they gather the sheets into complete sets and 'jog' them ready for binding. Some machines can be fitted with on-line stitching and folding attachments, so that the work is converted from printed stacks to finished reports in a single pass through the machine. Double-sheet and no-sheet detectors are used to ensure that every copy is fully assembled.

4.7.3 Binding

The requirements for binding R & D publications are essentially:

utility – the report should handle well and the pages should lie flat
versatility – the system should accommodate products ranging in size from a few pages to perhaps a hundred sheets or more, depending on the nature of the publication series.
security – pages must not become detached

The most common and economical method of binding reports is wire stapling:

(a) A single staple in the corner (corner pinning). This is adequate for a memorandum of a few pages, but is unsatisfactory for more long-lived publications.

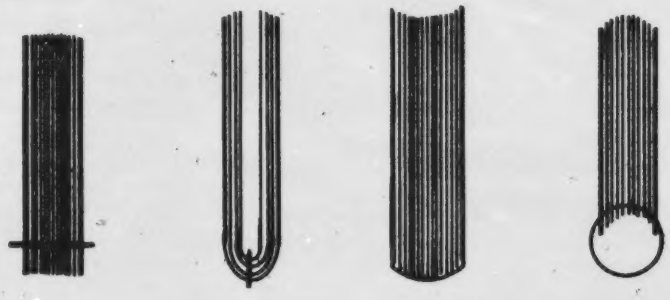
(b) Staples fixed through from front to rear of the stack of sheets (side-stitching – see Figure 11a). This is perhaps the most secure method; the spine may be protected and the sharp staple ends covered by tape if desired.

(c) Staples driven through the spine of a folded set of sheets (saddle-stitching – see Figure 11b). This gives a neat appearance but, unless care is taken, there may be a tendency for the central folded sheet to become loose. This method requires a double size litho press; an A3 machine will be needed to give sheets folding to A4 size.

Stapling by any of these methods is a cheap and secure method; the equipment ranges from simple hand machines to power-driven wire stitchers. The only problems arise with lengthy reports, when side stitching makes it difficult to

hold the report open, and saddle stitching is less practicable because of the problems of dealing neatly with a thick sheaf of folded pages.

Glue binding takes longer than stapling, but offers a neat finish, especially if a wrap-round cover is used, in the style of a paper-back book. This method, known as 'perfect binding', is used for this Agardograph Series (see Figure 11c). There is a risk that pages may become detached if glued books are continually pressed open, so wire stitching is sometimes used within the binding.



a Side stitching **b** Saddle stitching **c** Perfect binding **d** Spiral binding

Fig.11 Methods of binding

Spiral binding (see Figure 11d), using wire or plastic 'combs', allows the pages of a report to lie completely flat, which is ideal for reference purposes. These binders are relatively expensive, however, and their loose-leaf nature makes them unsuited for classified material.

This method of binding reports has a considerable effect on the shelf space needed for storage. When the thickness of the staples or paper fold is taken into account, the following approximations can be offered:

Packed paper before printing (90 gsm)	: 60 mm per 500 sheets
	= 2.4 mm per 20 sheets
Side stitching	= 3.2 mm per 20 sheet report (inc. covers)
Saddle stitching	= 4.8 mm per 20 sheet report (inc. covers)
Spiral binding	= 8 mm per 20 sheet report (inc. covers)

Thus, a 1-metre shelf will store 300 20-sheet reports in side stitched form, but only about 200 saddle stitched reports: although this latter number is dependent on the extent to which the folded sheets can be compressed.

4.7.4 Folding, Trimming etc.

Folded sheets are needed for saddle-stitched reports, although these may be produced on a combined collator-stitcher-folder. Separate folding machines are available for a variety of folding work; for report production the most likely need arises when an A3 'throw out' table or illustration is needed in an A4 book.

During the binding operation, the printed sheets are jogged tidily together but the neatness of the finished report is enhanced by trimming the edges in a guillotine. A power-operated guillotine is a feature of most litho finishing sections.

Copy numbering is often required for highly classified reports and is an important part of the document control procedure. It is possible to fit a numbering box to a litho press but, in view of possible spoilage, it is probably best to stamp the reports manually at the collating stage, destroying any spare copies or loose sheets. If highly classified work is involved, it may be necessary to certify that they have been destroyed in accordance with local security procedures. A heavy-duty paper shredder is a necessary item for any report production unit.

4.8 Re-orders

Figure 12 shows the general way in which printing bureau charges are related to the run length. The cost of internal production are likely to show a similar pattern, although probably at a lower level.

Figure 12 also serves to illustrate the extra cost of re-ordering a second run of a publication. In this example, two runs of 100 copies will cost about £8, compared to £5 for a single run of 200; for a lengthy report the difference can amount to a considerable sum.

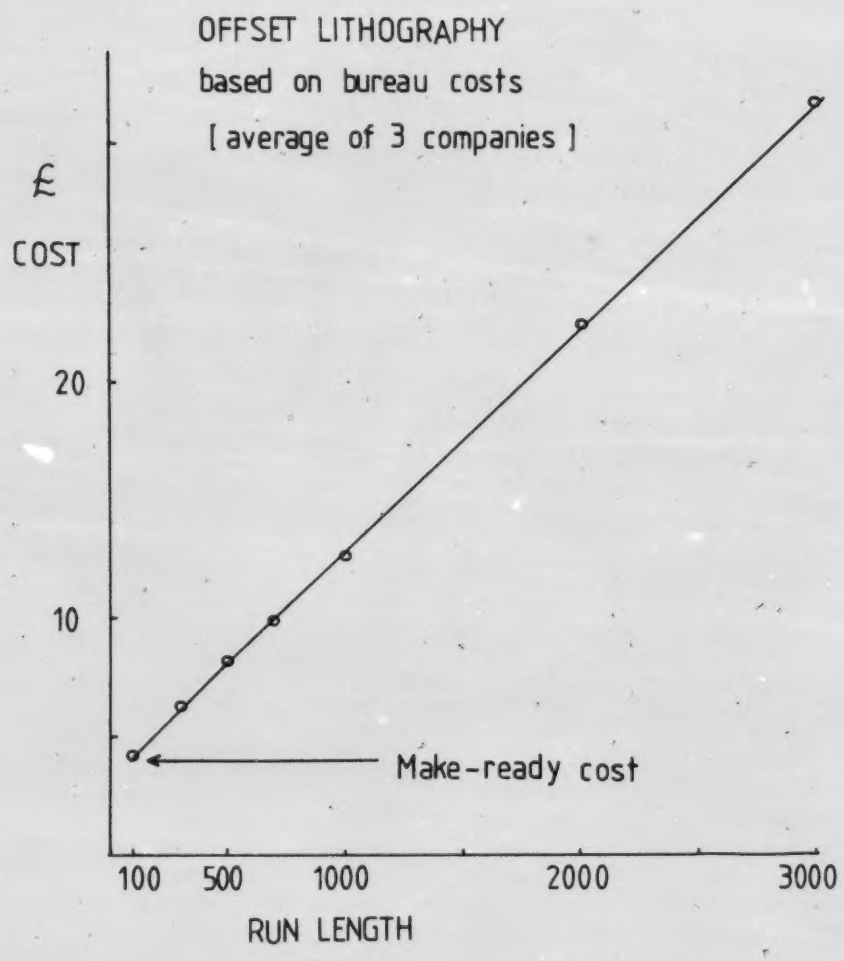


Fig.12 Offset litho printing: cost v run length

The make-ready expense of offset lithography arises from the need to make a plate and 'run-up' the press. The minimum charge, shown here as £4, is such that a small re-print of, say, 10 extra copies may effectively cost 20–30 times as much per copy as those produced in the initial run. In such cases, a photocopier will provide reprints much more economically – although this is an area in which microfilm also offers powerful advantages (see paragraph 5.2.4).

5. MICROFILM SYSTEMS

The literature contains many sources of reference to the technology and applications of microfilm (see paragraph 10.2); for the theoretical background the works by Nelson and Stevens[33,55] have not been surpassed. This chapter is intended to outline those aspects of relevance to scientific reports and related documentation, so that microfilm can be seen in perspective to the paper-based processes and systems.

5.1 Microfilm Formats

A number of microfilm formats have been developed to meet the needs of industry and commerce.

5.5.1 Roll Film

Where a large quantity of material is to be kept in strict sequence, it is appropriate to use roll film, preferably with a motorised microfilm reader to give rapid access.

(a) 16 mm film has a frame size adequate for filming A4 documents and is the most widely used roll film format. It may be stored on open spools, cartridges or cassettes. A 30 metre roll of 16 mm film will accommodate about 2800 images of standard A4 documents.

(b) 35 mm microfilm is primarily used in the form of aperture cards for engineering drawings (see paragraph 5.1.2), but it is also employed as a roll film format by some libraries for newspaper files.

(c) 70 mm and 105 mm roll film have been used for specialised purposes such as map copying. The most common application for 105 mm film is in microfiche roll film cameras, where it is cut into individual microfiche after exposure or processing.

5.1.2 Aperture Cards

For many purposes, microfilm files must be organised in a form where single images can be handled separately. The most familiar of these 'unitised' microforms is the aperture card, which consists of a single frame of 35 mm film mounted into a standard ADP data card.

Variations are possible, wherein a number of 16 mm or 35 mm frames are mounted into a single card.

5.1.3 Microfiche

The concept of grouping related frames on to a single piece of film finds its most common application in the standard 105 mm x 148 mm microfiche (the A6 paper size). Variations in fiche layout are shown in Figure 13.

The standard for document-based microfiche[14] assumes a reduction ratio of 24x and provides for 98 frames, each 10 x 12.5 mm. Many of the older 60-frame standard microfiche (reduction ratio 18x or 20x) are still in existence.

For computer output microfilm (COM) the BS 5644[15] quotes reduction ratios of 24x and 48x. In the former case, 63 frames can be accommodated in the 'landscape' style (corresponding to 14" x 11" computer output pages) or 98 frames in the 'portrait' style (corresponding to A4 pages). At the more common COM reduction of 48x, the microfiche can hold 270 'landscape' frames (6.25 x 7.75 mm) or 420 'portrait' frames (6.25 x 5 mm) (see Figure 13c-d).

The terms 'superfiche' and 'ultrafiche' have been used to describe various microfiche systems operating at high reduction ratios (in excess of 100x) and storing up to 3000 images. A number of non-standard microfiche formats, including the so-called 'jumbo' and 'super jumbo' fiche are used for catalogues, especially in the automobile industry[16].

5.1.4 Selection of Microfilm Format

For scientific reports, the most suitable format is the 98 frame microfiche. A single fiche can accommodate all but the longest reports and duplicates can readily be made on relatively simple equipment.

Some of the central archives in libraries and information centres may conveniently be recorded on 16 mm film, which can be loaded into cartridges or cassettes for use in a reader or reader-printer.

5.1.5 Microfilm Image Polarity

Microfilm systems offer the choice between a positive-appearing image (dark lettering on a clear ground) and a negative-appearing image (clear letters on a dark ground). It is generally felt that microfilm users prefer the negative mode of presentation:

(a) Dirt and scratches on the film are less annoying with a dark ground.

(b) A clear background tends to be glaring; hot spots from the optical system are more apparent and can be tiresome for long spells of reading.

On the other hand:

(c) The darkened screen surface is more likely to show annoying reflections

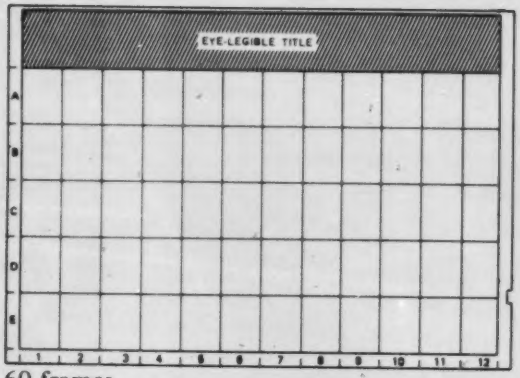
(d) Photographic illustrations are confusing when a negative tone rendering is used.

Despite the normal subjective preference for negative polarity, its popularity probably owes something to the simple fact that people are used to it. The processes commonly employed for document microfilming (silver halide film and diazo duplicates) give this dark-ground mode of presentation.

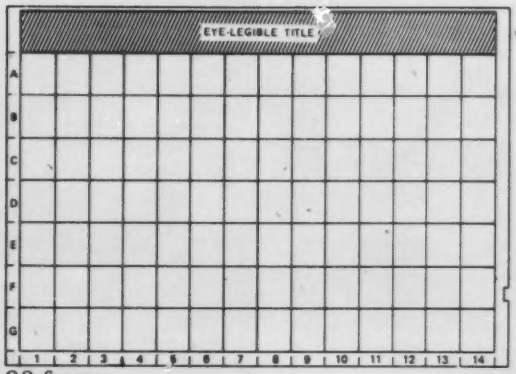
Photographic processes can be categorised as:

- sign-reversing processes, which change image polarity from positive to negative and vice versa (e.g. the standard silver halide process, vesicular films)
- Sign-maintaining processes, which produce negative images from negative originals (e.g. diazo films, the silver halide reversal process)

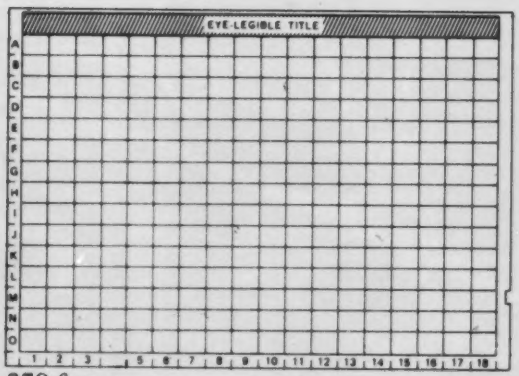
Conventional document-based microfilming proceeds from a positive original and requires a sign-reversing process for the camera stage, with a sign-maintaining process for subsequent duplicates. Computer output microfilm (COM) starts with a negative-appearing display, so a different approach is needed, in which a 'reversal' process is often used to give a negative-appearing master (see paragraph 5.5.5). It should be noted that this 'reversal' process (as in the popular colour transparency films) maintains the sign of the original; confusingly, it does not imply a reversal of the image polarity.



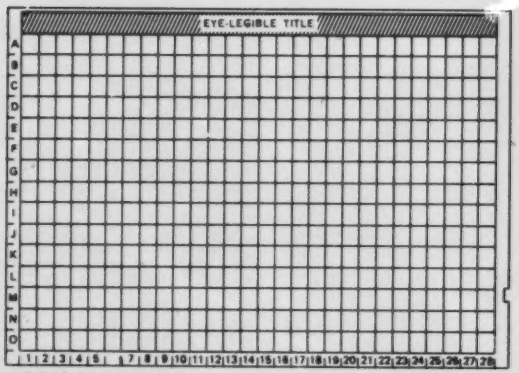
a 60 frames



b 98 frames



c 270 frames



d 420 frames

Fig.13 Standard microfiche formats

5.2 Microfilm Features

5.2.1 Summary of Advantages

(a) Reduced space

Microfilm can offer major savings in storage space (see paragraph 5.2.2), although this may only give significant savings in large installations.

(b) Improved access

The reduced bulk of microfilm can place more documents within easy reach of the archivist (within the same room, or within the same building) and thus tends to increase the speed of access.

(c) Greater security

The compact nature of microfilm assists its physical control (see paragraph 5.2.3)

(d) Cheap duplicates

The ability to duplicate up to 98 pages in a single operation offers obvious advantages compared to the alternative of photocopying from paper originals (see paragraph 5.2.4). In the case of COM, film can replace the use of expensive computer tape for data storage (see paragraphs 5.5 and 5.6).

(e) Insurance

The cheapness of duplicate microfilms makes it possible to keep an insurance copy of any vital documents without undue expense.

(f) Easy transportation

A single sheet of medium weight litho paper (80 gsm) weighs 5 grams; a standard microfiche with its protective envelope weighs about 7½ grams. For lengthy reports, useful savings in transport and postal costs are clearly possible (see paragraph 5.2.5).

(g) Speed of production

In general, large-scale microfilm production can be simpler and quicker than offset litho printing. In the case of COM, the greater speed is an important advantage compared to conventional impact printers and the productivity of the whole computer installation can be improved.

(h) Speed of re-ordering

Duplicates can be made with such ease that it is practicable to make them 'on demand' as the need arises. It is not necessary, as with litho-printed reports, to hold large stocks to meet possible requests for further copies.

Against the preceding benefits must be set certain disadvantages:

(j) Inconvenience

Many people react against using a microfilm reader, especially for continuous use of the sort associated with R & D publications . Even where readers are readily available for personal issue, the users generally prefer the ability to browse through a paper report, rather than adopt the more disciplined approach imposed by the microfilm structure. Bell[17] has reported that, while most scientists have a reasonably positive attitude to the use of microfiche, they will only accept microfiche where no eye-legible material is available. The reactions of librarians to the microfilm media have been studied by Woodend and Jardine[18].

The inability to make marginal notes is regarded as irksome by some users.

(k) Staff training

In some production units the reprographic staff undertake both microfilm and offset lithography; other units employ specialists for the two tasks. In either case, a separate training programme is needed for the operators.

(l) Organisation

The nature of microfilm is such that an effective index system is essential; any carelessness in filing will have even worse repercussions than with paper reports.

(m) Updating

With conventional microfilm it is not possible to amend individual pages. A correction to published report data requires a total re-issue of the microfiche.

(n) Installation cost

Many R & D establishments are already well equipped with microfilm readers and reader-printers, to give general access to film received from elsewhere: in most cases, a microfiche duplicator is also available for making copies of fiche for local distribution.

The additional cost of installing a complete microfilm production unit, with camera, processor and high volume duplicator nevertheless calls for careful consideration. Apart from the capital cost of the equipment, there may be considerable expense and inconvenience involved in the installation of a dark room with water supplies and drainage for processing the master negatives.

(o) Quality

With due care at all stages of production, distributed microfilm should transmit fully readable images to all

users, even where third generation copies are used. It must be faced, however, that many microfiche received in libraries are of low quality. After examining a sample of 90 microfiche reports, Horder[19] found that only 49% were completely legible without difficulty; 38% could only be read with difficulty and 13% were illegible to some degree. The largest single cause was evidently the quality of the original camera copy. The standard of the original typing and illustrations is crucial to the success of a report microfilming operation.

(p) Half-tones

Half-tone pictures or coloured illustrations can only be microfilmed by special techniques (see paragraphs 2.4.3 and 2.5.3). Distribution copies made on the normal diazo films are unsatisfactory for these categories of material.

The disadvantages of internal production of microfilm often centre on the problems of installation and finding suitable staff. When the volume of work does not warrant the setting up of these facilities, it may be possible to use a central government agency. Alternatively, a commercial bureau may offer a practical and economical solution.

5.2.2 Economy in Space

The space-saving advantages of microfilm are well advertised, and are attractive for a number of reasons:

Furniture and storage equipment is costly, especially for classified material

Archive space represents a major expense, where re-building or rental charges are involved.

Good storage conditions are necessary even when the archive areas are not continuously occupied. Temperature, humidity and cleanliness must be kept at a satisfactory level (see paragraph 5.3.6) and it is clearly economical to confine this expense to the smallest possible area.

Dramatic savings in space are often claimed for microfilm. Such claims are usually based on the mathematical fact that filming at a linear reduction ratio of 24x reduces the image area by a factor of 24^2 or 576; the film image thus occupies only 0.17% of the original paper area. However, the impressive theoretical savings must be related to the real needs of users and economies of this magnitude are unlikely to be realised in practice.

Example:

A conventional 98-frame microfiche is sufficient for many scientific reports. For the present purpose, one fiche is therefore regarded as equivalent to one paper report. A comparison of the space needed for fiche and paper versions of reports may be made as follows:

(a) Microfiche are normally made on film 0.007" thick (0.178 mm), which, for the purpose of calculation, may be rounded up to 0.2 mm. However, because of the risk of scratching and fingermarks, it is essential to keep silver masters and any diazo sub-masters in protective envelopes, which increases their effective thickness by about 4x. Ten microfiche in envelopes may be reckoned to occupy 8 mm and a typical drawer 300 mm deep will therefore hold about 375 microfiche.

(b) Paper reports may contain anything from a few pages to several hundred pages, but for the present calculation an average size of 50 pages is assumed (25 sheets, including covers). In side-stitched form such reports would each be about 4 mm thick (see paragraph 4.7.3). A collection of 750 paper reports would thus occupy about 3 metres of drawer space, which is more than can be accommodated in a standard 4-drawer A4 size filing cabinet (4 drawers x 550 mm deep = 2.2 metres). Six standard drawers would be needed (see Figure 14).

In this example, which might relate to a collection of material kept by a small research team, the comparison is between:

(a) 750 microfiche, which would require shelf space of 0.06 m^2 for a typical twin-drawer cabinet (200 mm wide x 300 mm deep x 275 mm high)

(b) 750 paper reports, which would require two cabinets (floor area 900 mm x 620 mm = 0.56 m^2.

Clearly, the microfiche file could be fitted on to a desk or shelf in most offices without any difficulty, whereas the paper reports would occupy floor space that might have other uses. However, microfilm is of no use without a film reader; this may occupy 0.25 m^2 of bench space, with still more room needed to make notes.

The example which is illustrated in Figure 14, has deliberately been put in the context of a small-scale installation, to make the point that the saving in space may not always amount to a great deal in concrete terms; the need for access to the film may negate most of the notional saving in floor space. The economies can be much more significant in large-scale installations; in the right circumstances reductions of more than 90% in storage area can be achieved.

5.2.3 Microfilm Security

Classified material is in many ways more secure on microfilm than on paper. It might be easier to conceal or lose a microfiche than a multipage A4 report, but the need for a film reader militates against casual access by unauthorised people. The reduced bulk also assists the physical control of the documents.

It has been suggested that on average nearly 6% of all paper documents become misfiled or lost[20]. Microfilm has a good reputation for maintaining file integrity, but this relates particularly to roll film. In the context of report microfiche, the advantages are not so obvious; once a fiche is misfiled in a large archive, its uniform appearance makes for difficulty in re-locating it.

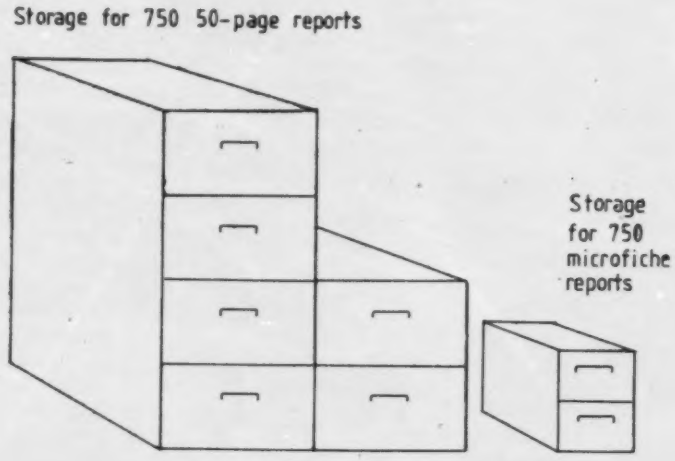


Fig.14 Reduced storage space required for microfilm

Security regulations must be enforced to control the production of microfilm print-out and duplicates; the use of reader-printers must be controlled in the same way as photocopiers.

Special shredders are needed for microfilm, which can reduced the film to very small chips or powder.

5.2.4 Microfilm Duplicates and Reprints

With conventional paper publications the production of additional copies by offset lithography is relatively expensive once the original run is completed. The need for re-printing may be minimised by filing a few spare paper copies, but this occupies valuable space and causes risks with classified material. However, using a microfiche master, a copy of the complete report can be made quickly and cheaply whenever the demand arises: some organisations will only supply re-orders in this form.

The economic advantages of microfiche for single reprints are shown in Figure 15, using typical bureau prices for comparison. Internal production costs differ considerably from these levels, depending on the local circumstances, but the overall ratio between paper and fiche copies will tend to be similar.

It is assumed here that a microfiche sub-master is available, from which the alternatives are:

(a) paper print-out, using a reader-printer

(b) duplication on diazo film (or vesicular film, for some COM applications)

In cases where a litho-printed report or the original camera-ready copy is available for copying, another option is available:

(c) photocopying

To offer a simple example of the cost of these alternatives for a single re-printed copy, the following approximation may be made for a 50-page report, using typical bureau charges:

Paper print out	12p per A4 page x 50	= £6.00
Photocopy	7p per page x 50	= £3.50
Diazo duplicate	12p per copy	= £0.12

As a rule of thumb, it may be found that a complete microfiche duplicate (which may contain up to 98 pages) costs no more than a single page of microfilm print-out; for a full fiche the cost advantage can thus approach 100:1.

The low cost of microfiche reprints does not, of course, invalidate the need for occasional paper prints (see paragraph 5.2.6), but it is a powerful argument against the regular provision of full-scale print-out.

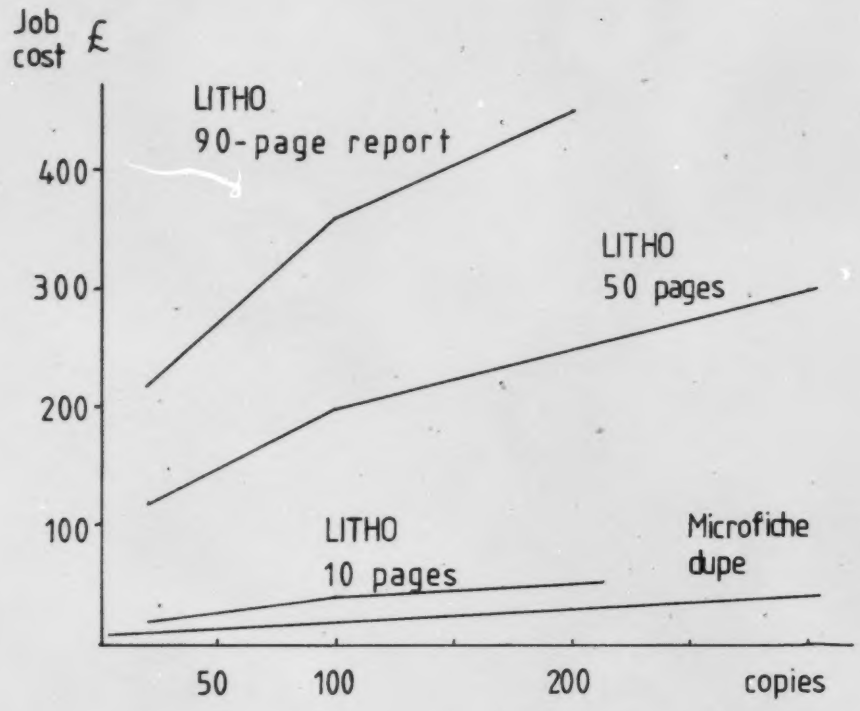


Fig.15 Cost comparison: microcopying v photocopying

5.2.5 Postal Charges and Transportation

A report comprising 24 A4 sheets (48 pages) on 80 gsm paper weighs about 120 grams; the covers will add another 15 grams. It currently costs 14p to send such a report by first class post within the UK.

By comparison, a microfiche weighs about 4½ grams, plus about 3 grams for its protective envelope. The cost for first class post in this case is 10p.

The advantage of microfiche is greatly increased for a batch of reports because the lower weight band of 0–60 grams allows 8 fiche to be sent for the same cost of 10p. The equivalent cost of letter post for 8 paper reports would be £1.22.

The physical movement of bulk publications is obviously eased by the use of microfiche. For example, a batch of five hundred 48-page reports weighs over 67 kg (148 lb) and represents a sizeable problem in handling, packing and lifting; delivery trolleys and despatch vehicles become a necessary expense. Alternatively, the equivalent stack of 500 microfiche and envelopes would weigh about 3.75 kg (8¼ lb) and could easily be carried by any messenger.

These factors, together with the cheapness of fiche duplicates, explain the popularity of microfilm with the distributors of scientific documentation. Virtually all overseas transportation of technical reports is by microfiche.

5.2.6 Microfilm Print-out

The protagonists of microfilm are reluctant to admit that there is any general justification for 'hard copy' prints from microfilm. However, although it is undoubtedly very expensive to make a full-scale print-out, there are certainly occasions when prints of key pages are essential, to give the user a reference copy of tables or diagrams.

It is usual, therefore, to provide a central reader-printer in a library and to apply due control in the interests of economy and security (see paragraph 5.4.7).

5.2.7 Access

In stating all the advantages of microfilm, it must be remembered that the success of such systems requires that all users should have access to a film reader. Bearing in mind that readers range in price from about £80–£100 for a portable model to about £150–£200 for a cabinet reader, it is clear that an investment of several hundred pounds may be needed to capitalise on the benefits of microfilm.

If this money is not available, it will be more practicable to retain a paper-based system; there is no point in adopting microfilm unless there is ready access to the records.

Vessey[21] has suggested that at least one microfilm reader should be provided for every team in an R & D laboratory, in addition to the central library resources.

5.3 Microfilm Materials

5.3.1 Silver Halide Films

The great majority of microfilm is originated on silver halide materials, employing the standard process (develop-fix-wash-dry) that has formed the basis of photography for the past hundred years or so. The prime advantage of these materials lies in their high film speed, which allows reasonably short exposures in a camera system. Other materials offer superior resolution and simpler processing, but with a few exceptions (see paragraph 5.3.4) their low sensitivity confines their use to duplicating systems that rely on UV contact printing.

Silver halide films are still sometimes used to make distribution copies of microfilm, where a positive-appearing image is needed, but for most purposes duplicates are made on diazo or vesicular films (see paragraphs 5.3.2 and 5.3.3). Colour films, which are based on silver halides with dye-coupling chemistry, are mentioned in paragraph 2.5.3.

The inconvenience of wet processing and the associated supply and effluent problems, which are especially undesirable in a computer environment, have lead to the introduction by 3 M and Kodak of dry silver films for COM applications. These are developed simply by the application of heat for a few seconds, which produces a silver image in exposed areas. A similar film, evidently with enhanced speed, is used in the recent 3M step and repeat document microfiche camera.

The long history of silver halide films and the extensive research into their image permanence brings them the advantage that their image life can be predicted with some confidence if due precautions are observed (see paragraph 6.2.4).

Special films have been designed for COM recording (see paragraph 5.5), to meet the need for very short exposure to CRT images and the possible need for reversal processing.

Photographic materials are made to a stringent specification and it is extremely rare for any operating faults to be attributable to the film stock. With correct storage in cool, dry conditions, unexposed microfilm has a shelf life of some years before the background fog level begins to increase.

5.3.2 Diazo Materials

Diazonium salts form the basis of a number of photosensitive processes and they provide the most common method of making microfilm duplicates. Their popularity arises from their cheapness (about 3p per microfiche), their high resolution (up to 1000 line pairs per millimetre) and the simplicity of the process. Diazo microfilm is normally 'developed' in ammonia gas although, as an exception, the new 3M Dry Diazo film is developed by heat.

Diazo films form a visible image by the combination of unexposed diazo salt with a dye coupler. A number of colours are available; blue is the most popular for microfilm because it gives good visual contrast, although black or sepia images offer somewhat better contrast for printing or the production of subsequent generations of duplicates (see paragraph 6.2.3). The process is positive-working and gives the preferred negative-appearing image from negative microfilm masters. All generations of diazo-copies are therefore negative-appearing, whereas negative-working materials such as silver or vesicular films change the image polarity alternately with each successive generation.

The sensitivity of diazo materials is confined largely to the ultraviolet. Their response to visible light is so low that they cannot be used for camera recording, although they are used in some high-energy laser COM systems. They can be handled in normal room lighting.

The storage life of these materials is of great interest because of their widespread use for microfilm – and the fact that diazo dyes are well known for their instability under strong light. Careful study under accelerated ageing conditions has indicated that if the films are stored properly in the dark their life should be in the range from 10–100 years[22], although for active records the twin problems of dark-ageing and light fading[23] make the prediction of image life very difficult[24]. The storage conditions should be as for silver halide films (see paragraph 5.3.6), although the two materials should not be mixed.

5.3.3 Vesicular Materials

The vesicular process is based on diazo compounds coated in a plastic binder. When the diazo salts are exposed to UV, nitrogen is produced as a decomposition product; 'development' then consists of heating the film to about 130–140°C for a few seconds. This causes the nitrogen to expand into small bubbles or vesicles (hence the name

'vesicular'). When the heat is removed, a crystalline shell is formed round each vesicle, which has the property of scattering incident light and thus rendering the image visible.

Once the image is formed, the film may be irradiated with UV in order to decompose the remaining diazo compound in previously unexposed areas. The nitrogen formed at this optional 'fixation' stage is allowed to escape naturally from the film.

The vesicular image has low contrast when viewed in normal diffuse light (see paragraph 6.2.3) and the 'eye legible' title strip on vesicular microfiche is not so easily read as with diazo films. However, in a condenser optical system such as a microfilm reader the image contrast is excellent. Resolution is good, although not quite so high as for diazo; figures of 200–300 line pairs per millimetre are achieved; there should be little loss of original film resolution, if the duplicating exposure is optimised. The nature of the vesicular image, a crystalline shell in an inert polymeric binder, would seem to make it an ideal archival material, provided that excessively high temperatures are avoided. However, no standards are established and, although it seem probable that these films will prove to have a long life, there is insufficient evidence at present to offer guarantees.

Vesicular films offer a clean-working process without any need for the disposal of water, chemicals or gas; the only by-product is heat, which can be dissipated in the office ventilation system. The process is negative-working and is used for duplicates when the master film has a positive appearance. This situation commonly arises in COM and the debate about the relative merits of vesicular and diazo duplicates for COM has been thoroughly reviewed by Horder[25], who concludes that there is a place for both materials in this field.

5.3.4 Unconventional Materials

The ideal microfilm camera material would have high sensitivity, high resolution, good image contrast, dry processing, extreme image stability and low cost. Additionally, for some purposes it is useful to be able to erase the image and record new data. Unfortunately, no material possesses all these properties: in particular, there is a fundamental difficulty in obtaining enough speed for the camera recording of normal documents. Until recently, only the traditional silver halide materials offered this capability, but the extensive research into new processes[26,27] has produced at least two commercial alternatives:

(a) The AB Dick/Scott 200 microfiche camera, which uses an organic photoconductor (OPC); images can be overprinted or cancelled and unused frames can be retained for later additions to the record[28].

(b) The Microx process, which was developed by General Electric, is based on a photoplastic film (PPF). After exposure and thermal development, the film carries an image in the form of microscopic plaster deformations. Any frame can be erased by local heating, which allows insertions, amendments or additions to be made.

In Section 4 Vol.II of this Manual, Petrie has mentioned a number of novel processes that are beginning to find applications for information storage (e.g. holographic memory systems) or for mass distribution of recorded data (e.g. video discs (see Reference 29).

5.3.5 Microfilm Print-out Materials

The older methods of microfilm printing, based on wet-processed silver halide document papers, are becoming obsolete except in specialised draughting applications. With the exception of the 3M Dry Silver and electrolytic papers, which are based on dry-processed silver halide materials, the dominant process for microfilm print-out is electrophotography (see paragraph 4.5). Coated papers are the most commonly used, but some plain paper systems are now offered which may have lower print costs.

5.3.6 Storage Conditions

The useful life of silver microfilm images is affected by two aspects of its treatment:

(a) the processing, of which the fixing and washing stages are critical (see paragraph 6.2.4)

(b) the storage conditions.

BS 1153[30] categorises storage conditions as 'archival' (the longest possible life) and 'commercial' (over 10 years); it makes the point that processing should be the same for both categories, because the film's eventual use is not necessarily known at the time of production. In practice, therefore, storage governs the permanence of the microfilm image, more than the film processing. Each producer of scientific reports must decide if anything more than the commercial standard is justified.

A summary of the storage factors will indicate the major implications of setting up a long-term archive:

(1) For commercial storage, room conditions should not exceed 25°C and 60% RH; protection must be given against fire, flood and chemical contamination.

(2) For archival storage, a temperature range of 15–20°C is preferred and the humidity should be between 20% and 40% RH. Air purification and air conditioning are also specified in addition to the precautions noted for commercial storage.

BS 1153 lists injurious storage materials and outlines the need for sealed airtight containers where the ambient conditions cannot be controlled.

BS 1153 relates only to silver film given conventional or full-reversal processing. All other films, such as diazo, vesicular, colour or partially-reversed silver film are excluded from its provisions. These films do not meet the requirement for an 'archival' medium, but the same general principles of controlled storage are appropriate and will be conducive to longer life.

The term 'archival permanence' is often used loosely, but it is now becoming accepted that it means 'lasting forever' – or, at the very least, lasting as long as the good quality paper currently used for archival storage.

This implies a life of some hundreds of years, which can only be achieved by the use of silver film correctly processed and stored under controlled conditions.

In their study of diazo materials, Adelstein and McCrea[22] introduced the description of 'medium-term' (over 10 years) and 'long term' (over 100 years), although they concluded that no diazo films meet the strict requirement for archival materials.

5.4 Microfilm Equipment and Methods

The equipment chain for producing microfilm is shown in Figure 16. The major aspect of choice lies in the type of camera: a 'step and repeat' camera produces finished microfiche (Figure 16a), whereas a 'planetary' or 'rotary' camera produces roll film for loading into cartridge or cassett (Figure 16b). Alternatively, by use of a 'jacket filler' the roll film can be converted into a microfiche format.

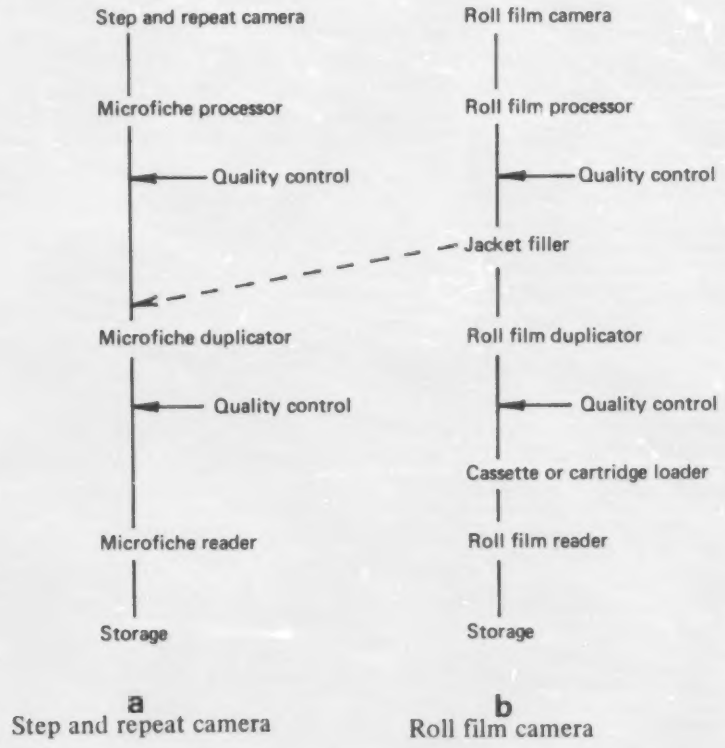


Fig.16 Microfilm equipment chain

There is a wide range of commercial equipment in most of these categories. The current market has been covered in the UK by Baker and in the USA by the National Micrographics Association (see Bibliography 2b).

Suggestions for the maintenance of microfilm equipment have been made by Jones[31].

5.4.1 Microfilm Cameras

(a) Step and repeat cameras

By moving a sheet of film into stepped positions behind a fixed lens, it is possible to expose rows and columns of images to conform to the standard microfiche formats. The film is carried in a cassette or 'dark slide' which can be removed for processing.

A necessary adjunct is a titling camera which will expose the usual headings in eye-legible size at the top of the microfiche. This feature is either built into the main camera body, with a secondary optical system, or is provided as a separate unit into which the film cassette is placed for titling.

Some cameras offer the ability to select from a range of microfiche formats (e.g. 98, 208 or 270 frames) with appropriate change of lens. The higher reduction ratios are compatible with COM microfiche, but are not normally recommended for document microfilming unless the originals are of sufficient quality to withstand the large reduction.

Most microfiche cameras use sheet film, but some deliver the film in the form of 105 mm rolls, which allows the use of the high speed roll-to-roll duplicators for the distribution copies.

Step and repeat cameras (see Figure 17a) offer the quickest method of making microfiche and produce the highest quality; they range in cost from about £5000 to £12000. Some have integral processors which can produce microfiche fully processed, but not archivally permanent, 90 seconds after finishing the exposure series. With manual feeding of the documents at, say, one every 6 seconds (600 per hour) a complete 98 frame microfiche would take about 12 minutes to produce.

(b) Roll film cameras

There are two basic types of roll-film camera:
'Planetary' or 'flat-bed' cameras – 35 mm or 16 mm film (some cameras accept both sizes)
'Flow' or 'rotary' cameras –mormally 16 mm film (except a few 35 mm cameras for filming computer stationery)

Planetary roll film cameras work on the same principle as a conventional miniature camera, exposing the images in sequence on to a standard 100-foot (30.5 m) spool which will accommodate 2500 frames. Title frames or 'flash' frames are introduced into the filmed sequence in order to aid subsequent visual searching; in some cameras coding 'blips' can be exposed on to the film to permit automatic retrieval in a special roll-film reader (see paragraph 5.7.2). Simple cameras of this type are priced in the range of £600–£1000.

Rotary cameras operate at high speed by filming single sheets as they are driven on a continuous belt past a fixed lens. The film is moved at a corresponding speed behind a narrow slit in the focal plane and a sharp image is preserved despite the continual movement of the original. The film transport is actuated by the insertion of a document and, with suitable paper-feeding attachments, can record lengthy material, such as trace-recordings, or computer fan-folded stationery in a single continuous image.

Flow cameras are not expected to give the very highest optical quality, but they are widely used for filming cheques, vouchers and correspondence and give adequate results even with such mixed material. With good originals, such as are prepared for reports, the image quality should be entirely satisfactory[32].

These cameras are designed to deal quickly with large quantities of documents and the limiting factor is usually the rate at which the operator can sustain in feeding the material into the camera throat (probably in the range 1000–2000 per hour). Auto-feed machines are capable of much higher output.

It is unlikely that a publishing organisation would install a rotary camera for report microfilming, but if such a camera is purchased for other reasons, it would be practicable to use it for making microfiche on a small scale, using a jacket filler (see paragraph 5.4.4).

Flow cameras range in price from about £1000 for a simple machine, to about £4000 for a camera with automatic feed, automatic exposure, interchangeable lenses and the ability to record simultaneously the front and back of documents (duplex recording).

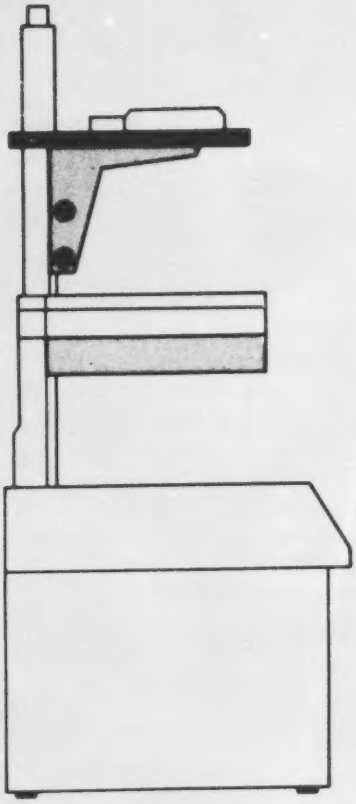
5.4.2 Film Processors

For document microfilming, the standard photographic process is used, to make a conventional negative: in the case of COM, a more complex 'reversal' process is sometimes used (see paragraph 5.5.5). In either case, the use of pre-mixed liquid chemicals helps to ensure clean and consistent results.

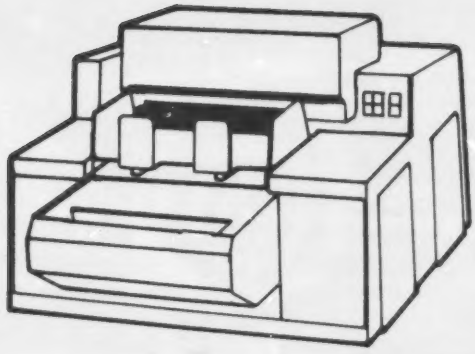
Continuous film processors are used to control the solution temperature and process time and to ensure appropriate agitation. In the larger machines, the solution activity may be adjusted by controlled replenishment.

When buying a film processor, there are a number of points to observe:

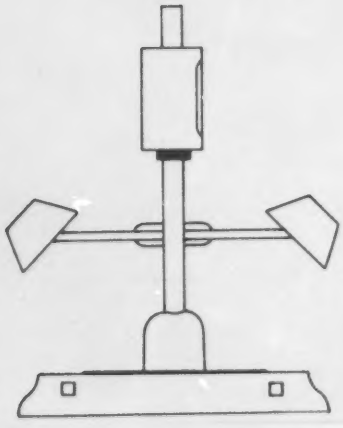
The machine speed
The 'dry to dry' time for a complete spool or sheet of film to pass through
The effectiveness of solution circulation
The feed mechanism – must a leader be fitted to the film before loading?
The control of machine speed and temperature
Washing efficiency (films can vary in their rate of fixation and washing[60].)



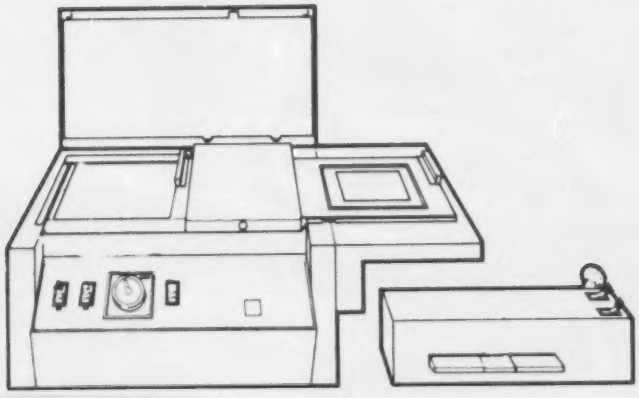
a Step and repeat microfiche camera (GAF 8000 GC)



b Typical roll film 'flow' camera



c Planetary roll film camera



d Microfiche duplicator (GAF 1050, 1051)

Fig.17 Microfilm equipment

The need to provide water and drainage for a processor can cause difficulty at some sites; for this reason, some machines can be operated in a free-standing mode, with containers to collect the spent solutions and using a still-water final rinse. This is suitable for many commercial applications, but the resulting image life is likely to be measured in months or a few years at most, which is not generally acceptable for report microfilm masters. The desire for 'instant access' is understandable, but is largely incompatible with any plans for archival permanence.

In addition to the drainage load of wash water, the disposal of waste developer, fixer and bleach solutions needs consideration for environmental reasons. It is a common practice to sell the spent fixer and bleach so that the silver content can be recovered.

The installation of a film processor brings the need for a weekly cleaning routine, machine maintenance and regular (perhaps daily) process control checks by a trained technician.

5.4.3 Quality Control Equipment

In order to ensure that the microfilm product is of high quality, certain items of equipment are necessary (see also paragraph 6.2)

Gloves – for handling the master microfilm
Densitometer – for checking film density
Low power microscope (about 50–100x) – for checking resolution tests
Laboratory glassware – for carrying out chemical tests
Microfilm viewer – for checking legibility, correct sequence, image cleanliness etc.
Illuminated bench – for general inspection

Large-scale microfilm producers will also concern themselves with the measurement of film bow, brittleness, film adhesion tests etc.; the full range of such tests has been outlined by Nelson[33]. Advice on the handling of micrographic materials has been given by Jones[34].

5.4.4 Jacket Filler

By use of microfilm jackets, short lengths of 16 mm microfilm can be converted into a block of images similar to a microfiche. The jacket filler incorporates a viewing screen, so that the images can be checked prior to cutting and inserting. This approach also allows the jacket to be used as an active file, adding new frames as required. The necessary eye-legible title is usually typed on to the jacket heading area or on to adhesive film.

Diazo duplicates can be made from the jackets, although they are not as neat as those made from a step and repeat camera. The equipment for making fiche by this method (a simple planetary camera, processor and jacket filler) is much cheaper than a step and repeat camera. The method is used by many of the smaller microfilm bureau and may be of value to publication units that have only occasional need for microfiche, especially where the camera and processor are available for other purposes.

5.4.5 Microfiche Duplicators

The diazo process requires a UV source for exposure and an ammonia chamber for development (see paragraph 5.3.2). In its simplest form, as in the equipment used for diazo lecture transparencies, the facilities for diazo fiche duplicates may cost about £400 or less. However, output will be limited to about 15–20 fiche per hour and most microfilm production units have more powerful duplicators with an output of around 100 an hour, for which £1000–£1500 is the more likely price range. High-volume diazo duplicators with automatic collators are able to make 1500 fiche per hour; high-speed roll-to-roll duplicators are also available with a capacity of 250 feet per minute.

The vesicular process (see paragraph 5.3.3) requires only a UV source for exposure, and heat for development. The equipment ranges from simple units for low-volume users at about £500 to high-speed roll-to-roll duplicators costing about £10,000, which are capable of making 1800 fiche per hour.

5.4.6 Microfilm Readers

A microfilm production unit needs viewing equipment so that the images can be checked for correctness of sequence, legibility and any sign of damage (see paragraph 6.2). It is essential to avoid damage to the film master and good quality equipment must therefore be used; the cost is likely to be in the order of £150–£200, rather than £100 or so for a portable reader. Motorised roll-film readers are naturally more expensive, in the region of £500.

A useful source of impartial advice on microfilm equipment in the UK is offered by the National Reprographic Centre for Documentation (NRCd); details of this service and the Guides by Baker are given in the Bibliography. The NRCd evaluation reports for microfilm readers cover many practical details such as ease of use, engineering and safety standards, as well as quantitative measurement of resolution, luminance and temperature.

BS 4191[35] gives a specification for microfilm readers, covering such aspects as focus adjustment, machine stability, film temperature and electrical characteristics: a resolution test film is included as an appendix to the standard.

An introductory guide to the selection of microfilm readers is described in Reference 36.

5.4.7 Microfilm Reader-printers

A printer is not normally needed for the microfilm test routine, but it provides an essential part of the production facility in support of any library or information centre.

The cost of an A4 reader-printer is likely to be in the range of £900–£1500, although the more versatile machines accepting several roll and fiche formats may cost up to £2500. Production printers, capable of making 10 prints a minute are available for about £7000.

The materials used for microfilm prints are mentioned in paragraph 5.3.5.

5.5 Computer Output Microfilm (COM)

The principles of computer output microfilming and current developments in this field have been covered in detail elsewhere[37,38]; the present description will be confined to an outline of COM and a discussion of those aspects related to scientific documentation.

5.5.1 Applications of COM

The primary advantage of COM lies in its ability to produce computer output at much greater speed than a conventional line printer. The compact form of the output (typically at 42x or 48x reduction) brings all the attendant economic advantages of microfilm.

COM techniques are applicable for any data stored in a computer or in some compatible form. They may be considered for publication work wherever computer-based storage is used for reports text. Such organisations will be able to gain the benefits of word processing or photo-typesetting to make high quality masters for litho printing, using the same data base to produce COM masters for simultaneous microfilm publication.

5.5.2 The COM System

The processing and distribution of COM film follows the same principles as for document-based microfilm, although the greater speed and larger scale of operation have brought some novel features to the microfilm field.

The essential feature of COM lies in the origination of the material which, after data preparation in the host computer, is transferred to a cathode ray tube (CRT), where it is converted to a visible form on the fluorescent tube face. The display is photographed by a precision camera, using a film specially designed for the requirements of COM. An alternative approach, employed in COM recorders by 3M and Kodak, is based on a laser which writes directly on to the film.

As shown in Figure 18, a forms overlay feature allows standard outlines or additional graphic material to be photographed in superimposition with the CRT display.

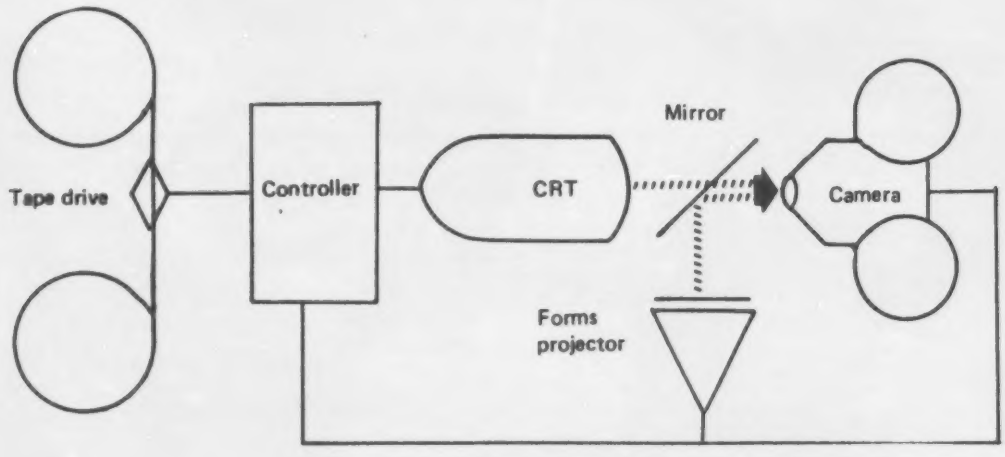


Fig.18 Basic COM system

Some COM recorders operate on-line to a main frame computer, but it is often more convenient to work off-line, writing the data to tape which can be loaded into the COM unit. The concept of off-line recording brings problems of compatibility, especially where tapes from a number of sources are coded differently. This has lead to the distinction between:

(a) 'front-ended' or 'intelligent' COM recorders, which have a mini-computer capable of re-formatting any input tape; this converts the data and instructions to a form suitable for the recorder.

(b) 'non-intelligent', 'fixed-logic' or 'dumb' COM recorders, which cannot carry out any pre-processing of the instructions from the originating computer.

A non-intelligent recorder is considerably cheaper than an equivalent front-ended machine, but it places additional work on the host computer which may well increase the overall cost. These recorders can usually be up-graded by the addition of a mini-computer 'front-end'.

The factors affecting the choice between intelligent and non-intelligent COM recorders have been outlined by Terry[38]. The software requirements of both types of recorder have been described by Audley-Charles[39].

5.5.3 COM Performance

Some COM recorders have a peak character transfer rate in the order of 100,000 per second, although a more suitable measure of performance is the average number of pages per minute, which includes the time taken by line and page shifts. Output rates of current alphanumeric recorders are in the range 100–300 frames per minute; a complete microfiche will take only a minute or two to record.

A typical page capacity for a COM frame is 80 lines of 160 characters. The height of the characters is typically in the order of 0.1–0.2 mm and line widths may be down to 0.01 mm or less.

These figures for printing speed and image packing density illustrate a remarkable level of performance when compared to litho-printed publications. The image quality is also of a high standard and may be enlarged to make litho plates.

Alphanumeric COM recorders offer a basic set of 64 characters, but this can usually be extended to 128 characters or more. The most powerful systems produce over 200 characters or programmed symbols at various sizes, from a number of type styles. In such cases the COM recorder is acting in a similar fashion to a high-speed photo-typesetter.

The format and quality standards for COM have been the subject of publications by BSI[40] and NMA[41,42].

5.5.4 Graphical COM

Graphic COM recorders are used to produce computer-generated drawings, maps, simulated 3-D models and to present statistical data in visual form. They replace mechanical flat-bed plotters in much the same way that alphanumerical COM recorders replace impact printers. The speed of plotting may show a gain in the order of 1000x: hours of valuable computer time can be reduced to a matter of a minute or two.

The quality of COM graphics is high, with precise line positioning and programmed variation of line width. For illustrated manuals, a graphic COM recorder can produce all the line diagrams and text, although they way in which the characters are drawn makes them inherently slower than the purely alphanumeric systems.

Some alphanumeric recorders offer the possibility of merging graphic material into a written report by use of the forms overlay feature. The illustrations are previously filmed and mounted into projection slides or aperture card mounts, which can be brought into the camera optical system as required. The slide changeover time is about 2 seconds and a publication can be filmed at high speed, mixing the text and illustrations by programme command.

Figure 19 shows examples of COM output. It should be noted that this litho reproduction has been taken from electrostatic prints made at 48x enlargement from second generation diazo duplicate fiche. It is a tribute to the quality of the original COM silver films that the material retains legibility after this complex reproduction chain.

5.5.5 Features of COM

There are many successful COM installations in commerce and Government administration and their use has extended to libraries (see References 43, 44, 45). In the particular case of report production, a comparison between COM and conventional document-based microfilm may be made as follows:

(a) A fundamental difference lies in the simplicity of the COM process. The information passes from a computer store or off-line tape, via the output CRT directly to the film. The transfer therefore takes place virtually at the speed of light: there is no typing, no intermediate 'camera copy' and no separate filming operation.

FLOREY-FORBES DATAGRAPHIX SYSTEM 4500 FILM SAMPLE - AUTHOR CATALOG

FLOREY, ERNST.
An introduction to general and comparative animal physiology. Philadelphia, W. B. Saunders Co., 1966. xi, 713 p. illus. 26 cm.
Includes bibliographies.
QP31.F65

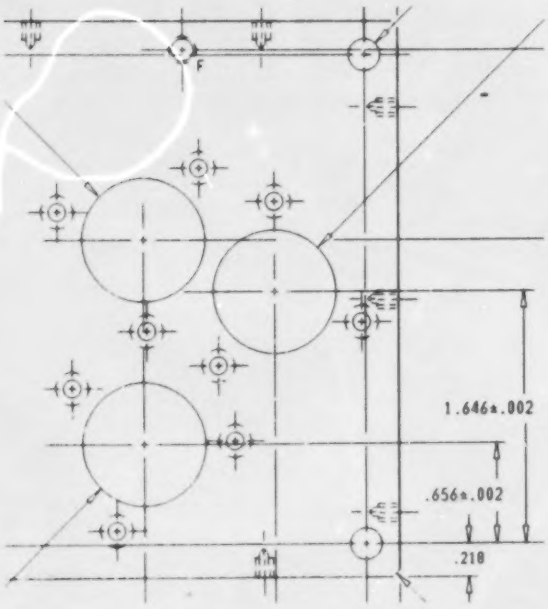
FLORIDA. LEGISLATIVE REFERENCE BUREAU.
Legislators' handbook on Florida government, 1963. Tallahassee? 1963. 1 v. (unpaged) illus., map. 27 cm.
Cover title.
JK4438.A5 1963

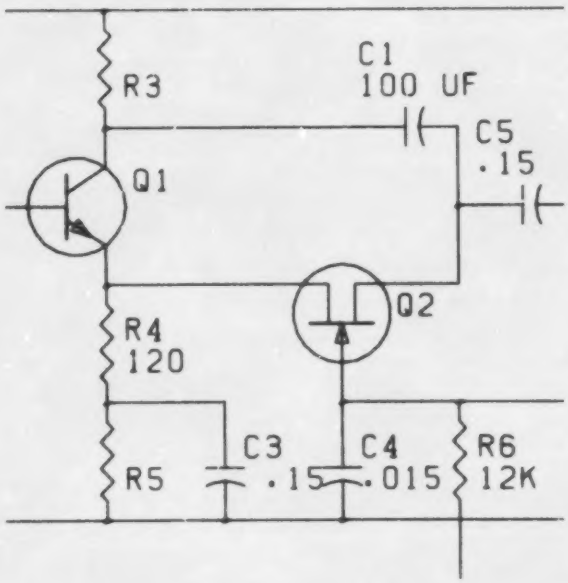
FLORIDA. UNIVERSITY, GAINESVILLE.
UNIVERSITY OF FLORIDA MONOGRAPHS.
HUMANITIES, NO. 24.
Sims, James H.
Dramatic uses of Biblical allusions in Marlowe and Shakespeare. Gainesville, University of Florida Press, 1966. 82 p. 23 cm.
PR2676.S5

FLOURNOY, THEODORE, 1854-1920.
James, William, 1842-1910.
The letters of William James and Theodore Flournoy. Edited by Robert C. Le Clair. Madison, University of Wisconsin Press 1966. xix, 252 p. port. 23 cm.
BF109.J28A4

FOERSTER, NORMAN, 1887-
Eight American writers, an anthology of American literature. Norman Foerster & Robert P. Falk, general editors. Contributing editors: Floyd Stovall and others. 1st ed. New York, Norton c1963. xvi, 1610 p. 22 cm.
Bibliography: p. 1589-1605.
CONTENTS: --Edgar Allan Poe.--Ralph Waldo Emerson.--Henry David Thoreau.--Nathaniel Hawthorne.--Herman Melville.--Walt Whitman.--Samuel L. Clemens.--Henry James.
PS535.F6

a Alphanumeric recorder





b Graphic recorder

Fig.19 Examples of COM output

(b) The image quality of the recorded CRT characters is much better than with typewritten material. Typographic variations such as bold or italic letters are available on some alphanumeric recorders.

(c) The effective image reduction (normally 48x) and image packing density of COM (up to 420 frames) ensure that virtually every report will fit on to a single microfiche.

(d) COM units vary in their output rate, but figures of 300 A4 pages per minute are not exceptional. This may be compared with a line printer (typically 20 pages per minute), or a word processor (in many cases about 1 page per minute) or a manual typewriter (about 10 minutes per page, for a typist working non-stop at 40 words per minute).

These maximum rated speeds are not a satisfactory guide to potential output, especially in the case of a typist, but it is clear that a system capable of printing a lengthy report in about one minute, with processing completed in a further few minutes, will bring a fundamental change to an organisation with traditions of typewritten and litho-printed reports. High-speed duplicators allow this impetus to be maintained, with an output of several hundred microfiche per hour.

(e) COM installations range in price from £30-40,000 for a basic recorder, to about £50-60,000 for an 'intelligent' front-ended unit with integral film processor. Graphic COM recorders cost from about £80,000 upwards.

Despite its advantages for large-scale users, no-one is likely to install a COM unit solely as a replacement for a small microfilm publishing activity based on typing and a simple fiche camera. It will only be viable as part of an organisation with a large computer facility and a requirement for COM output perhaps in the order of 1M frames a year of more.

For those with an occasional need, COM bureau offer a complete service; over 30 UK companies and 45 European bureau are listed by Baker[37]. There are normally setting-up or formatting charges, but once these are met, the production charges may range from approximately £1–£2 for the master fiche, with duplicates costing from £0.07 to £0.15 depending on quantity.

5.5.6 COM Processing

The output screen on a COM recorder produces bright characters on a dark ground, which is described as 'negative appearing'. The standard process for silver halide films (develop, fix, wash) is negative-working, so the resulting COM film is positive-appearing (see Figure 20). In these circumstances, vesicular films are normally used to give the preferred negative polarity for the distributed film.

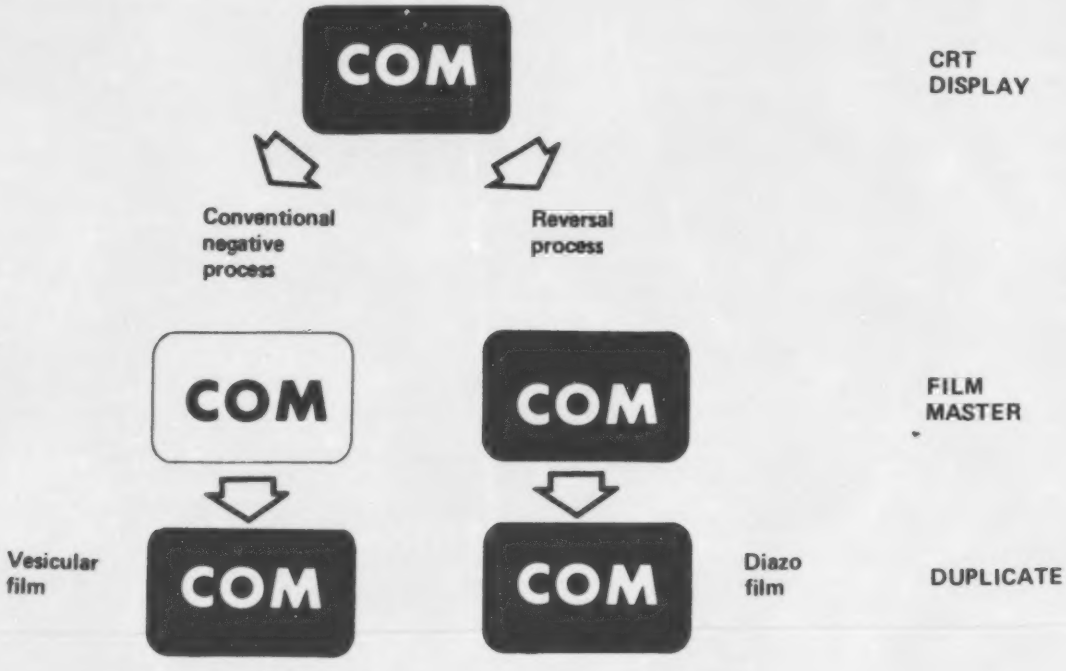


Fig.20 COM processing procedure

The required negative appearance can be achieved on the master film by the use of a 'reversal' process. The full reversal process can give archival permanence but is lengthy and relatively complex (develop, bleach, clear, re-expose, re-develop, fix, wash) and requires a special processing machine. An abbreviated process known as 'partial reversal, or 'halide reversal' (develop, bleach, wash) gives an image of silver halide instead of the conventional silver image. The choice of processing and duplicating method (see Reference 25) is shown in Figure 20:

(a) conventional processing, followed by duplication on vesicular (or silver) films,

(b) reversal processing, followed by duplication on diazo films.

5.6 Computer Input from Microfilm (CIM)

The COM techniques outlined above allow alphanumeric or graphical data to be transferred directly from computer to microfilm. It is possible to operate the opposite process, whereby alphanumeric images on microfilm can be scanned and converted to digital form on magnetic tape. This can be stored or fed into a computer for interpretation and further processing; output can be in the form of COM, or type-set film for litho platemaking if required.

The CIM concept allows 35 mm or 16 mm film to be used for computer archives instead of the normal magnetic media; film is a cheaper storage medium than tape and may offer more convenient reference.

In some cases the CIM film may be produced by COM techniques, 'dumping' the computer data on to film. More often, the system works from 'hard copy' such as typewriting, computer print-out or even hand printing. The error rate is very low (less than 0.05%) and any unidentifiable character is displayed for a decision by the operator.

As far as the author is aware, the only CIM unit at present available is the Information International Grafix I, which is a highly sophisticated image processor and image analyser. Several variations are offered on a basic configuration costing in the order of £1,500,000. Ross[47] has outlined its application for CIM in the US Navy and the British Department of Health and Social Security. Tarbet has also described the DHSS system, which can read 5M characters a day from hand written input[48].

5.7 Microfilm Retrieval

The undoubted benefits of microfilm and the persuasion of the market place should not blind prospective users to the fact that many documents need not be stored at all; the most useful decision may simply be to destroy them. In our desire to participate in technological change, we should remember that the first question to be posed is "Why do we need to keep these records?" Only when the real need has been studied can the most appropriate storage medium be selected. In some cases the needs of the users can be met most suitably by the retention of paper records; in other cases a conversion to microfilm may have positive advantages.

To the user of microfilm, the most important factor is the ability to retrieve the required images. All the advantages claimed for microfilm are spurious and all the 'economies' are pointless unless the user can gain access to the information quickly and reliably. The system will usually be planned from this end-point; deciding the most appropriate film format and reference method before working back to select the most appropriate production hardware.

In a useful review of retrieval methods, Bolnick[49] has discussed the influence of computerised search techniques on microfilm systems.

5.7.1 Microfiche Retrieval

The microfiche is the most commonly-used microfilm format for scientific reports; it is a convenient size for handling and its indexing and storage cause few problems. Small files can be kept in standard office furniture, or in easel binders to conform with any required method of subject classification. There are many automated fiche retrieval systems, including computer-aided installations; these may be more appropriate to commercial and banking users, who want to make a quick reference to single entries, rather than the reader of scientific reports, who normally want to read extended passages.

The eye-legible title on a fiche offers help in the first stage of deciding whether the document is of sufficient interest to warrant taking it to a reader. Some libraries offer a useful second stage of reference by making an A5 size print-out of the microfiche index or abstract page and tucking it into the fiche storage envelope.

The physical conditions needed to ensure long life for microfilm records are outlined in paragraph 5.3.6.

5.7.2 Roll Film Retrieval

Roll film is the easiest microfilm format to produce, but it poses problems of indexing and retrieval. Using a rotary camera, collections of old publications can be committed to film at the rate of several thousand pages per day (see paragraph 5.4.1). This is obviously a quick way of dumping a paper store on to film, but it suffers from some disadvantages compared to microfiche:

(a) a given publication cannot be extracted for duplication

(b) the motorised readers that are necessary for rapid searching are expensive

(c) indexing is essential to identify the content of each film.

For publication work, where the stored pages are in blocks of, say 10–100 pages a roll of 16 mm film may contain 25–250 reports, all filmed in some pre-determined sequence. Some aid to searching the roll is necessary:

'Flash' frames to separate the image blocks.
Use of a frame counter ('odometer') with an associated index for each roll.
'Code lines' or 'blip codes' recorded on the film.

Film coding can be linked to electronic frame counters and used with key-board operated search programmes to form a hybrid computer-microfilm information system.

5.8 System Design

There are many thousands of microfilm systems employed effectively for scientific documentation and it is hoped that this Chapter will have pointed to some of the reasons for considering the application of microfilm in this field. But it must not be taken for granted that microfilm holds the key to all the problems of information storage and retrieval; nor should it be assumed that the newer, more fashionable methods will always be the best. Every potential application for microfilm must be studied carefully:

- The needs must be analysed and criteria established for a successful scheme
- Alternative solutions must be explored, including possible paper-based (non-microfilm) solutions
- The benefits of different solutions must be evaluated and a choice made
- The implementation must be planned in detail, with due regard to environmental factors and staff attitudes; arrangements must be made for a systematic review of the scheme once it has been in operation for a period.

The fundamentals of the step-by-step approach to system implementation are covered by Petrie in Section 4 of this Manual. A thorough investigation of the sort proposed here requires the professional approach of a management services specialist or microfilm consultant (see References 38 and 50).

6. QUALITY CONTROL

For the present purpose, 'quality' may be identified with success in meeting the needs of the readers of R & D publications. It embraces aspects of appearance, but is more concerned with the effectiveness with which the essential communication is carried out. For the system designer, quality control raises implications in terms of staff training, organisational procedures, the establishment of standards and the continual feed-back of corrective action.

6.1 Printed Publications

6.1.1 Quality Assurance

Quality control is part of the routine of every microfilm producer (see paragraph 6.2) but it is not always applied so formally to printed paper publications. Nevertheless, unless certain standards and procedures are laid down, the quality of publications is likely to vary, as it becomes subject to personal preferences and the exigencies of the changing situation. Most organisations strive to achieve consistency in their publications – although it is not easy to say how much this is to be 'valued' in comparison with the necessary expenditure.

The concept of quality assurance is an accepted part of most industrial processes and the same critical approach can be extended to the production of technical literature. Tilly[51] has outlined the application of quality control methods to instruction manuals. Defects in both form and content of the publications are categorised and the numerical weighting of each type of defect allows an 'acceptable quality level' to be quantified and agreed between the contracting parties.

In a related field, Brill and Fields[52] have described the application of 'value engineering' to measuring the effectiveness of technical handbooks. They outline a scheme for establishing the functional value of a publication, based upon responses to questionnaire tests. The scores from the tests can be used to compare the predicted and actual value of the work and also allow comparison of different publications.

It is not suggested here that a highly structured defect analysis should be adopted for scientific reports, but some form of checking procedure is obviously needed. The nature of the problem is outlined in Table 5, which lists the facets of report production that contribute to the quality or effectiveness of the printed publication.

6.1.2 Defects

To adapt the terminology of quality assurance, it is possible to place the defects of a publication into 'critical', 'major' and 'minor' categories. In Table 5 these are shown as categories A, B and C respectively.

TABLE 5

Printed Publications – A quality Check List

	Responsible for Original Execution	*Responsible for Checking*	*Level of Importance*
Scientific & Technical content			
Effective contribution to the R & D *research* aims	Author	Project leader	A
Required coverage of subject	Author	Project leader	A
Accuracy of data	Author	Project leader	A
Presentation			
Logical structure of report	Author	Editor	B
Suitable language for readers	Author	Editor	B
Clarity of expression, brevity	Author	Editor	B
Style, readability	Author	Editor	B
Accepted spelling, grammar	Author	Editor	B
Consistent units, abbreviations	Author	Editor	B
Appropriate use of illustrations	Author	Editor	B
Correct references	Author	Editor	B
Complete table of contents	Author	Editor	C
Correct security classification	Author	Editor	A
Content of title page	Author	Editor	B
Format			
Paragraph numbering	Author	Editor	C
Line spacing, margin settings page length	Typist	Supervisor	C
Layout of title page	Typist	Supervisor	B
Mechanics of preparation			
Typing: evenness of impression	Typist	Supervisor	C
neatness of corrections	Typist	Supervisor	C
neatness of Tables	Typist	Supervisor	C
correct maths layout	Typist	Author	B
Drawings: Consistent line weight	Illustrator	Supervisor	B
comprehensive annotation	Author	Editor	B
clarity	Illustrator	Author	B
Photographs: viewpoint, lighting quality, sharpness, tonal rendering, required detail	Photographer	Author	A
comprehensive annotation	Author	Editor	B
Materials			
Paper quality: weight, surface, colour	Litho operator	Printing supervisor	C
Production			
Printing: even inking, clean background	Litho operator	Supervisor	B
correct backing-up	Litho operator	Supervisor	A
consistent positioning	Litho operator	Supervisor	C
half-tone reproduction	Process camera Litho operator	Supervisor	B
Finishing: no extra pages	Collator	Supervisor	B
no missing pages	Collator	Supervisor	A
correct sequence in all copies	Collator	Supervisor	B
neat trimming	Guillotine operator	Supervisor	C
secure binding	Collator	Supervisor	A
Administration			
Meeting agreed deliverydlate	Publication Manager	Project leader	A
Providing appropriate distribution list	Author	Project leader	B

Matters such as accuracy of data and freedom from ambiguity are crucial to the acceptability of a report in scientific circles; similarly, the correct security classification is vital to the organisation concerned. Any defect in this 'A' category would require the issue of a correction slip or the withdrawal of the report. Some specified errors might involve mandatory reference to a higher authority for disciplinary action.

Other faults, such as wrong spelling or inconsistent abbreviations, would rarely cause complete misinterpretation of the work, but they cause irritation to the reader and can have an unfortunate effect on the credibility of the issuing body. Such defects (Category B) should obviously be corrected at the preparation stage, but if perchance they escaped notice until the work was distributed, total re-printing or re-issue of the report would not be warranted. Repeated occurrances of this type would show the need for improved training in both the operator and those responsible for the checking.

Minor features, such as inconsistent line spacing or uneven inking are more cosmetic in their nature, but act cumulatively to lower the reputation of the publishing body. Though not serious in themselves, they show a careless attitude that may be more difficult to eradicate than occasional mistakes of a more serious category.

Table 5 shows an example of the way in which the listed defects might be categorised, although there are no fixed rules in such things. For example, a poorly-lit photograph could represent a critical defect (some vital detail obscured by shadow) or a minor irritation (uneven background lighting). Or the inclusion of an extra page, which might normally be regarded as a silly mistake by the collator, would be a cause for alarm if the report were highly classified, as it would be evidence of careless document control.

Different organisations, having identified their own objectives for their publications, will set their own standards accordingly: they will also differ in the way in which the checking is carried out. Figure 21 shows the points at which quality control may be needed in the report production cycle.

6.1.3 Format Standards

Effective checking procedures call for the establishment of agreed standards. In the case of printed publications, the 'tools' of quality control are:

- A guide to report format – structure, page layout, style of illustrations
- An agreed dictionary – accepted spellings
- A set of standard publications – agreed abbreviations, international units symbols – a list of those available from the typist or photo-typesetter.

Such matters must be the subject of agreement between the authors and the production staff (typists, illustrators and printers). In some organisations a publication Editor acts as arbiter in cases of difficulty.

Further references to format standards are given in paragraph 3.6.

6.1.4 Defect Analysis

All printed publications are likely to contain mistakes; incorrect spelling is commonplace in newspapers and often occur in books, despite the employment of specialist proof-readers. The correction of these errors is time-consuming and expensive: sometimes the mistake is noticed and corrected immediately; sometimes it involves the re-working of several stages of production. Systematic checks offer an essential safeguard against the publication of serious mistakes, but the procedure can only add to the general expense and does not in itself prevent errors. The fundamental cure to the problem is to improve the level of awareness and to improve skill by adequate training programmes.

In order to identify the areas for action in any process, it is useful to record the nature and frequency of corrections at each stage over a period of time. This may reveal, for example, that some authors consistently demand large-scale changes when confronted with their fully prepared 'camera-ready' copy; this would indicate the need for improved drafting and approval procedures. On a more physical level, the number of reports returned with loose binding may suggest that substandard materials are being used.

The maintenance of records also has value in relation to machine defects. All breakdowns, service calls and replaced parts should be noted so that the running cost of each machine can be assessed over its full life.

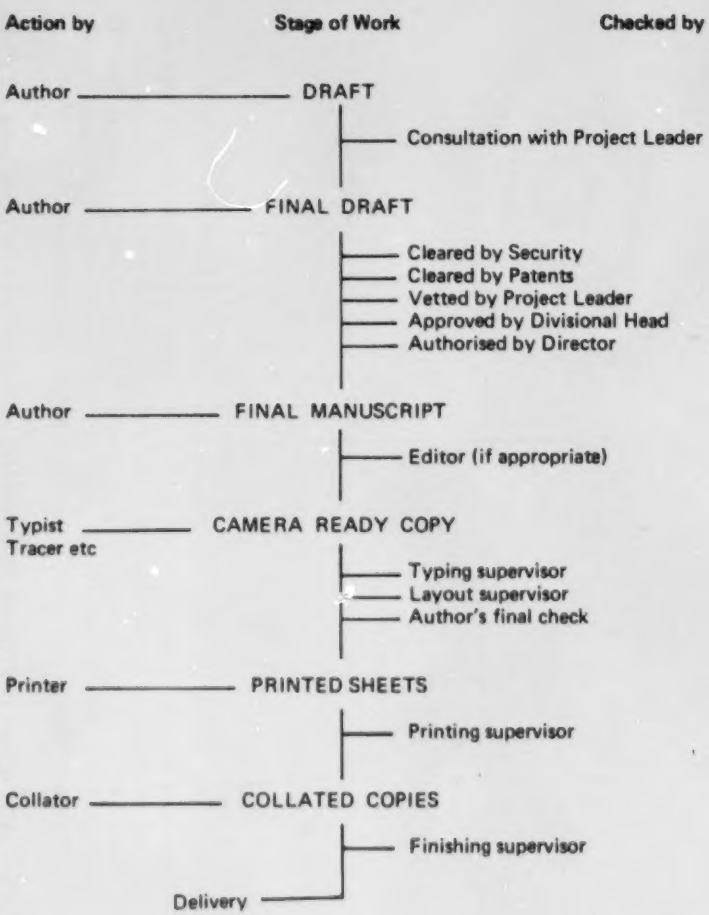
Spelling mistakes are probably the most frequent errors in written work but, arguably, their very obviousness makes them harmless for the educated reader. Other faults, such as an imprecise aim for the report, poorly structured work, or obscure and ambiguous language do far more harm to the general process of communication. This is a subject outside the scope of this Manual, but it forms part of any overall assessment of the 'quality' of a publication. Training in effective report writing is necessary for any scientist, technologist or administrator; a number of useful works for further reading are listed in Reference 10.

6.2 Checking Microfilm

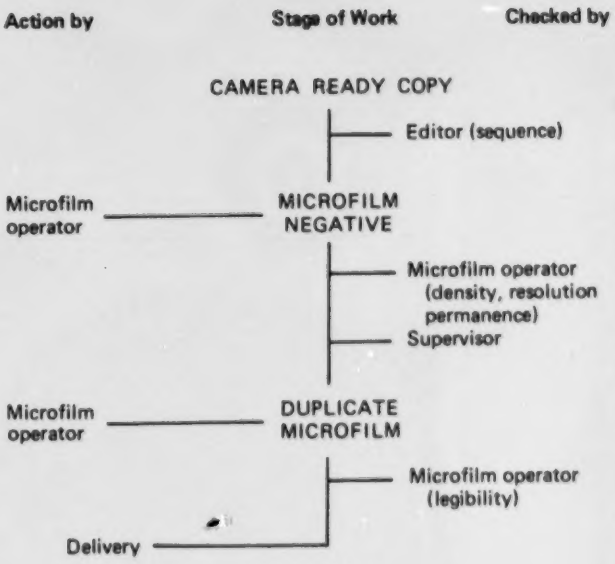
Reports generated on microfilm naturally need the same checking of content and layout as for printed publications. In addition, because of the nature of the microfilm image, a number of specific tests are prescribed.

The aspects of microfilm quality may be grouped as follows:

- Physical dimensions (film size, reduction ratio, image position, film curl)



Litho printing



Microfilming

Fig.21 Checking routine for scientific publications

- Film density, contrast
- Image quality (resolution, legibility)
- Cleanliness, film damage
- Image permanence
- Completeness of information (correct sequence, indexing).

Freedman[53] has described the operation of a thorough programme for microfiche quality assurance, in which defects are classified into 21 attributes.

6.2.1 Microfilm Dimensions

The dimensions of film and the image positioning are largely beyond the control of the microfilm producer, but they affect the utility of the product and may form part of a testing routine.

6.2.2 Microfilm Resolving Power (see BS 4657[54])

The visual quality of a microfilm image is related to the ease with which it can be read ('legibility') and used to make duplicates or prints ('printability', sometimes termed 'reproducibility'). These properties are affected by:

(a) the optical resolution of the entire system (film, camera, duplicator, reader),

(b) the density levels of image lines and the background.

Microfilm media differ in their image reduction scale, but they share a general requirement for high resolution. An A4 page of conventionally typed text, when reduced to a standard 98-page format, occupies an area of 8.75 x 12.38 mm; each lower case character is in the order of 0.08 mm high. In Computer Output Microfilm, where the effective reduction ratio is 48x, each character is about 0.2 mm high; individual lines are in the order of 0.01 mm wide.

In his classic work on high resolution microphotography, Stevens[55] has formulated the description of image quality as 'perfect', 'excellent', 'commercial' and 'decipherable'. In the latter category, some letters cannot be identified and must be deduced from the context of the words.

The attainment of high resolution is a complex task, particularly when it must be maintained in high-volume production. The resolution of the film (about 200 line pairs per mm) is more than adequate, but care is needed at every stage because small degradations are soon compounded to produce noticeable deterioration.

Every step in the production routine requires attention:

The original 'camera copy' must be of good quality.
The camera stand must be stable and free from vibration.
The focussing mechanism must operate correctly.
The lens must be clean, to minimise scattered light.
The film must lie flat within the camera gate.
Exposures must be controlled to give the required film density ($D = 1.0 \pm 0.1$).
Processing must give adequate contrast between lines and background.
When making duplicates, good contact is needed in the printer.
Correct exposure and development are necessary for any duplicates.
Film viewing or print-out equipment should be correctly set up.

It must be realised that the human eye is more tolerant of density variation than are duplicating or print-out materials. Microfilm that is judged to be marginally legible may be virtually useless if further generations of duplicates are required from it. The criterion of acceptability depends upon the application; BS 5525[56] specifies that maps and similar originals should be reproducible up to the third generation of microfilm.

If a microfilm camera has been correctly set up and maintained, and the procedure standardised, a drop in film resolution is unlikely to arise; the most common reason for poor legibility is a poor quality original document.

The quality control routine normally calls for resolution test targets to be filmed at the start and end of each roll or on each microfiche. A low-power microscope is used to inspect the microfilmed test pattern and ensure that the prescribed standard is met. Attainment of the required standard in the test frames gives reasonable assurance that the system resolving power is being maintained throughout the filmed material. Additional checks of legibility on sample frames serve to confirm that vibration or other occasional influences are not affecting the image quality.

The evaluation of microcopying system resolution has been discussed by Horder[57] with particular reference to the National Bureau of Standards (NBS) test chart and the International Standards Organisation (ISO) 'mire' test character (see also References 58, 59).

6.2.3 Microfilm Density

Microfilm emulsions are made to close tolerances; when they are stored properly and given the specified treatment they will give the required density with great consistency. In principle, however, microfilm density varies for two reasons:

(a) variation of exposure,

(b) variation of development.

It is clearly necessary to identify the cause correctly and it is a job for a trained technician to investigate and correct any deviation.

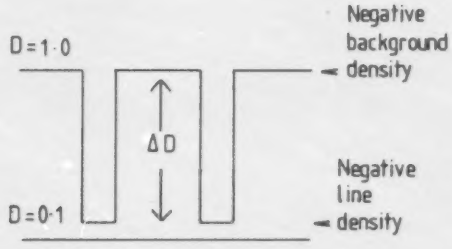


Fig.22 Microfilm density levels

Ideally, a microfilm image should have two density levels only (see Figure 22). If the density difference does not reach a certain level, the image lacks contrast and will not yield satisfactory duplicates or prints. The standards for microfilm negatives require a background density of 1.0 ± 0.1, which gives an indication of the close control that is necessary for microfilm exposure and processing.

Resolution is at a maximum when film density is about 1.0; higher levels may give increased visual contrast but bring a greater tendency to graininess and image spread.

The image quality of microfilm depends to a large extent on the density profile within the fine lines of the image (in the order of 0.02 mm wide), but the measurement of these line densities calls for a specialised microdensitometer. Normal procedures therefore involve the use of conventional densitometers to measure relatively large areas (e.g. 2 mm diameter), plus the visual judgement of line quality in a microscope or high-magnification reader.

A densitometer is a necessary instrument for any unit wishing to operate in a systematic way, checking the film against the standard or making process control measurements. However, for the small user, who is unwilling to meet the cost of a photoelectric densitometer, it is possible to make a visual comparator that will serve most purposes. Frames of film are exposed to give the specified minimum and maximum densities and are mounted on the inspection bench. The human eye is very sensitive to side-by-side comparisons and is easily able to detect if any subsequent film is outside the range of the comparison frames.

The requirements for the process control of COM film have been outlined by Hayday[46].

Ultraviolet density

Microfilm duplicates are commonly made from silver film masters on to diazo or vesicular materials, which are UV sensitive. The important property of the image on the master film is therefore its ability to absorbe UV radiation – which may be different from its density to visible light. A normal silver image is visually neutral and shows substantially uniform absorbtion throughout the visible and near UV regions; a measurement of the visual density of these films therefore correlates well with the UV density.

Black-image diazo films are also reasonably neutral in these spectral bands, but blue diazo films, although having a pleasing visual contrast, have a relatively low UV density which gives a low duplicating contrast. It is for this reason that black diazo films are used to make further generations of diazo duplicates, rather than the cheaper and faster blue-image films.

A conventional densitometer is entirely adequate for measuring silver films, but an ultraviolet densitometer is required for the systematic production of diazo sub-masters that are intended for further duplication.

Specular density

Film density can be measured by diffuse light (diffuse density) or by a collimated beam (specular density); the latter gives a higher value because light is lost by scattering from the optical path. The ratio between the specular and diffuse densities of a film material is termed the Callier coefficient (Q).

The processed images in silver and diazo films, which function by absorbing light, show little difference between diffuse and specular densities. Vesicular films (see paragraph 5.3.3) function by scattering the incident light and have an effective density which is highly dependent on the geometry of the optical system. The specular density of these films is thus considerably higher than their diffuse density (their Callier coefficient is 2.0 or more).

Normal densitometers are designed to measure diffuse density and are thus well suited for silver and diazo microfilms, irrespective of whether these are to be used in projection or contact systems. The measurement of vesicular films, however, requires a special densitometer, with a condenser optical system effectively similar to that of microfilm viewing equipment. For the high-volume production of these films, a specular densitometer is required for effective testing, but infrequent users of vesicular films are unlikely to feel that the cost of such a machine is justified. Visual checking against known standards is probably sufficient, together with occasional print-out tests to ensure that printability is maintained.

6.2.4 Tests for Image Permanence

Silver halide film, when properly processed and stored, will remain satisfactory for several decades or even for centuries. Controlled storage conditions are essential (see paragraph 5.3.6) but a low level of residual chemicals in the film is a pre-requisite for good image stability. The deterioration of silver film, which may show itself as discolouration or as fading, has two causes:

(a) insufficient fixation, which leaves unstable silver salts in the emulsion,

(b) insufficient washing, which leaves fixing salts (sodium or ammonium thiosulphate) in the emulsion, where they will eventually attack the silver image.

These problems are prevented by (a) the use of fresh fixing solution and (b) by attention to water temperature and flow rates. Such matters are often taken for granted, but there is an inescapable need for chemical tests to check that processing has been adequate.

BS 1153[30] specifies the chemical constituents of a fixing bath and gives details of a number of tests for residual thiosulphate and silver compounds. The most accurate quantitative analysis of thiosulphate content is given by the methylene blue test, which requires rigorous chemical control. Those without the necessary resources may prefer to use an independent testing laboratory[60].

BS 1153 further recommends that microfilm records should be subject to continuing visual inspection. A representative 20% sample should be checked every two years, including 2% of the sample from material previously inspected.

There are no standard methods for testing the permanence of diazo or vesicular films, or the unconventional silver halide processes such as dry silver or halide reversal (see paragraph 5.5.5).

6.2.5 Image Sequence

Microfilm, whether in roll or fiche, must be examined to ensure that the images are properly orientated and in the correct sequence. In this visual check, it is also appropriate to look for film scratches, fluctuations in density and any unusual marks – for which an explanation must be found.

7. STAFFING

7.1 Introduction

Staff costs are the major expense in most activities and this is certainly true in the field of scientific report production. On the other hand, a skilled publication team is a major resource and should make a valuable contribution to the overall effectiveness of the organisation.

It is important that anyone planning new reprographic or microfilming facilities should understand the implications of staffing. This chapter is intended to outline the range of skills needed for a publication unit and points, albeit cautiously, to the numerical strength needed.

7.2 Job Categories

There is a balance to be drawn between versatility and staff specialisation. Some of the stages in publication work call for considerable expertise and no-one can be expected to be a skilled practitioner over the whole range; some specialisation is therefore inevitable. On the other hand, few units will seek to employ people exclusively for one reprographic job. The normal compromise is to group the work functions, so that people in each section can be trained to carry out a range of related work. In the UK Civil Service, where there is a close definition of work categories, the following structure is normally observed, with posts graded within each occupational group, according to the level of ability required and the supervisory responsibility.

Manuscript typing	– Typist (with mathematics allowance)
Tracing, art-work, annotations	– Graphics Officer, Tracer
Photography, bromide prints, copy negatives, screen negatives	Photographer
Plate-making Litho printing Photocopying Collating, binding Microfilming, processing	Photoprinter

In some organisations there is a rigid demarcation of job function, in others there may be considerable freedom in allocating the duties. Versatility is generally to be welcomed, but even with the most willing of staff, there are limits to the range of skill that can be expected. It is suggested that the four categories of staff shown above represent acceptable boundaries of personal expertise and therefore lend a natural shape to the publication unit.

7.3 Organisation

Many organisational structures have evolved to provide reprographic and microfilm services to research establishments and information centres. The basic tasks of report preparation and production are similar in most cases, but there are many factors that have produced different forms of centralisation or functional grouping. There is no evidence to suggest that any approach is better than another, although some of the more fragmented arrangements might be expected to experience problems of co-ordination.

Despite the preamble, it seems useful in this discussion to postulate a structure for a publication unit. This will identify the necessary elements and leave the reader at liberty to re-cast the size or shape of the organisation to suit different needs. The supervisory structure is the most variable feature in such organisations; the pattern in Figure 23 has been shown largely to make the point that professional supervision and clerical support is needed for effective operation.

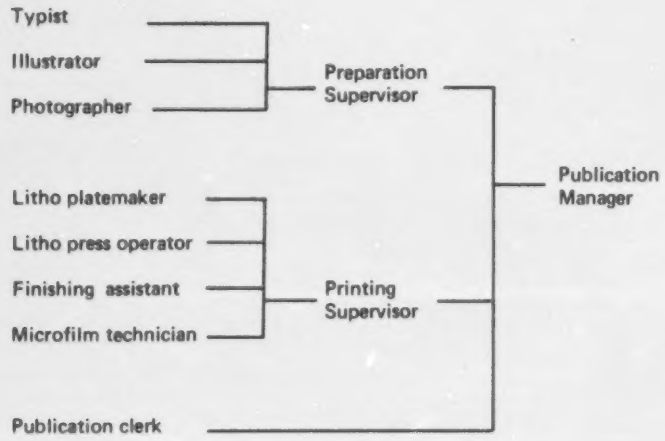


Fig.23 Publication unit – possible supervisory structure

A total of 11 job titles is shown in Figure 23, but it is not in any way suggested that a team of 11 people represents the minimum viable unit size. Nor is it suggested that this is the appropriate balance of expertise for all circumstances. In most cases, certainly with smaller establishments, these staff will be partly engaged in other tasks (administrative typing, preparation of lecture material, printing of forms etc.) that fall outside the publication field.

7.4 Staff Numbers

The number of staff employed in producing scientific documentation for an R & D organisation is presumably related to the volume of reports written and hence, in some way, to the number and activity of authors among the scientific and technical staff. Published figures for UK Civil Service[61] indicate that, on average, for every person preparing general text or other printed matter (grades such as typists, illustrators, photographers, duplicator operators and photoprinters) there are 25 other staff (scientists, technologists, administrators and support grades), who are 'customers' in the sense of being potential authors or readers of official paperwork. This average level of support (4%) may not be found in R & D establishments, where a figure of 2–3% is probably more common. Furthermore, it must be expected

that in the Government Service as a whole, much of this support will be employed for 'administrative' paperwork; the proportion engaged in producing 'scientific documentation' within the context of this Manual is more likely to be in the order of 1%. Thus, for an establishment of 500 total staff, it may be found that the equivalent of 5 people are in various ways engaged in producing scientific and technical reports as a supporting service for 100 or more potential authors.

There is no fixed basis for the approximations given above, the appropriate staff levels must be found by close examination of the volume of production, checked by independent inspection as necessary. The requirement will be greatly affected by the aims of the research group as a whole: the 'productivity' of the group in terms of scientific publications may depend, for example, on the balance between 'research' and 'development'.

Various factors of scale affect staff complements and a higher ratio of support staff may be needed in small establishments. For example, with a total staff of 100, one person could clearly not be expected to cover all the activities needed to prepare and print scientific reports. In such cases, where the staff totals are small and the need for report work is irregular, the viability of local resources must seriously be questioned; a central agency may be able to give a cheaper and more comprehensive service. On the other hand, it is generally felt that an 'on the spot' service is more efficient in ways that cannot readily be expressed in monetary terms. It is the accepted policy of most research groups that local facilities are beneficial and this calls only, perhaps, for the comment that the overall cost of these activities should be known in sufficient detail for a rational decision to be made about their provision.

The selection of staff for publication and reprographic work follows the same general principles as for any other field of activity; the Printing and Publishing Industry Training Board[62] has produced a guide on recruitment and selection that is particularly pertinent. Job descriptions and personal specifications are drawn up, vacancies are advertised and the applicants are short-listed; interviewing is sometimes supplemented by practical tests.

7.5 Training

7.5.1 Training Programme

In simple terms, the training needs of a working section may be met by:

(a) defining the job requirements, by reference to a set of job descriptions,

(b) assessing the staff capability,

(c) designing the content of an appropriate training programme,

(d) deciding the method of training and providing the necessary resources,

(e) assessment of the effectiveness of training,

(f) re-design of the content or method of training if necessary.

A publication unit employs a number of different specialists, so the total training programme is likely to be complex. It will cover different levels of ability and will embrace both technical studies and supervisory attributes. Furthermore, the needs of the situation are not static: new staff are employed, new techniques are introduced and the trends of activity within the organisation may change. In practice a training review of the unit is required at least once a year, in addition to the day-to-day oversight of the individual's progress.

The development of an effective training programme calls for collaboration between training specialists and line managers. The specialist supervisors in typing, illustrating, photography and reprography will generally be aware of the training opportunities in their field and should be encouraged to keep in touch with their professional bodies.

Where major innovations are made, such as the introduction of word processing or the expansion of microfilm facilities, the training process must extend beyond the operators and their supervisors. In such cases, the broader benefits of re-organisation may be lost unless authors and other users are familiar with the proposed changes. If everyone understands the capabilities of the new system they are less likely to cling to older, less efficient methods. In many cases, the human reaction to change presents a greater challenge to management than the technical aspects or the financial implications.

7.5.2 Training and Education

There is a tendency on the part of some equipment suppliers to suggest that their systems need little skill to operate. This must not be taken to imply that the range of equipment needed for a publication unit can be effectively operated without properly trained staff. The value of technical training is now generally recognised by management and staff alike: in the larger organisations, where career planning is taken seriously and there is an emphasis on staff development to meet future promotion needs, there tends also to be a broader educational purpose rather than a narrow task-centred approach.

The jobs involved in producing scientific documentation embrace several disciplines but the range of training and educational opportunities is basically similar to that in other fields:

Training on the job.
Internal courses – induction, safety practice, management.
College courses – professional qualifications, specialised short courses.
Summer schools, Commercial training schools.
Professional society seminars, Conferences.
Exhibitions, Trade shows, Manufacturer's demonstrations.
Technical journals, Trade press.
Periods of external experience, temporary transfers.
Informal visits to other working groups.

Mere attendance at a course or any other form of training gives no guarantee of its effectiveness: follow-up and re-inforcement is an essential part of the learning process. Furthermore, proper feed-back of the results is a necessary part of the training programme, allowing it to develop to meet the changing needs of the organisation.

At the very least, investment in training may be seen as a necessary adjunct to the expenditure on equipment; in a broader sense, the encouragement of personal development represents an investment in the future effectiveness of the organisation.

Appendix A

NATIONAL MICROFILM SOCIETIES

The International Micrographic Congress (IMC) is a body which draws together the various national microfilm groups around the world. I am indebted to the Microfilm Association of Great Britain for the complete list of 34 societies from which I have extracted the following for AGARD member countries:

Canada
Canadian Micrographic Society
P.O. Box 6084, Station 'J'
Ottawa, Ontario, Canada

Denmark
Dansk Micrografisk Forening
c/o Nova Mikrofilm A/S
1610 Copenhagen V, Denmark

France
CIMAB
rue de Castellane, 4
75008 Paris, France

Germany
Ausschuss für Wirtschaftlichte Verwaltung
Frankfurter Allee 55-59
6236 Eschborn 1
Federal Republic of Germany

Italy
Associazione Italiana di Microfilme
Corso Venezia, 16
20100 – Milano, Italy

Norway
Norwegian Microfilm Association
c/o Kodak Norge A/S
Tolbugaten 35
Oslo 1, Norway

The Netherlands
Nederlandse Microfilm Associatie
Dorpsstraat 35, Holysloot (gem)
Amsterdam, The Netherlands

United Kingdom
Microfilm Association of Great Britain
8 High Street
Guildford GU2 5AJ, England

United States of America
National Micrographic Association
8728 Colesville Road, Suite 1101
Silver Spring, Maryland 20910, USA

Readers in countries not listed above may be able to obtain details of microfilm activities from the International Micrographic Congress, at P.O. Box 22440, San Diego, California 92122, USA.

Appendix B

PUBLICATION COSTS

B.1 INTRODUCTION

Organisations differ in their approach to costing information: some firms charge for their work according to a fixed price list, others estimate the cost for each job in advance and carefully monitor any variations from this figure. Internal printing units may also 'charge' their product to specific projects, but if there is a large number of small jobs the value of detailed cost-attribution is questionable. It is more common for publication and reprographic work to be regarded as part of the general overhead and allocated to projects with the other administrative support activities.

There is no standard method for producing scientific documentation, and no universally agreed basis for assessing the cost of such an operation – although in the United Kingdom many commercial printers adopt a method established by the British Printing Industry Federation[64]. A related approach to reprographic costing and management is being developed in the UK Civil Service under the title of System 3.

This Appendix has been included to give an indication of the types of cost incurred in the processes of report production. In order that an example can be worked through, it is proposed to make some assumptions so that the order of cost involved can be shown. The intention is to outline the costs of preparation and production, albeit in a simplistic way, but the use of such figures to derive 'selling charges' to customers is outside the scope of this paper.

It should be noted that the chosen examples are purely hypothetical and serve only to stimulate thought on the subject and promote cost consciousness.

B.2 COST VARIATIONS

The costs and prices used in this Appendix seek to reflect the UK market levels in mid-1979 but should be treated with caution for the following reasons:

(a) Any attempt to quote cash figures for salaries or equipment is fraught with difficulty, because of inflation and the continual variation in international exchange rates.

(b) Even within the same country, there may be regional differences in items such as salaries and building costs.

(c) The nature of the research work can greatly affect the cost of the ensuing reports. For example, if half-tone illustrations are never to be required, there can be major savings in terms of staff expertise and facilities.

(d) The extent of the demand for 'urgent' work affects the need for high-speed equipment. Such machinery is naturally expensive and if it is under-utilised the job costs are presented at a relatively high level – although this may be judged to be unimportant by comparison with the value of quick transmission of the report contents.

(e) Equipment prices differ greatly according to the detailed specification; a price range of 2:1 is not uncommon (see Table 7). Discount arrangements may also affect the purchase price.

(f) Material costs are highly dependent on the quantities ordered; considerable savings are sometimes possible with bulk buying.

(g) The length of a printing run is a vital factor in determining the cost of any publication (see paragraph 4.8).

(h) The cost of production depends to some extent on the standards set for the finished work. Any form of quality control brings an associated expense.

(i) The quantity of the work dictates the size of the publication unit, which tends to affect the operating efficiency and hence the cost. There is a general tendency for large production units to benefit from the effects of scale, but productivity is not solely governed by the amount of money invested, nor by the number of people employed. Staff attitudes have an intangible but inescapable effect on running costs and a small team may be at no disadvantage in this respect.

(j) Organisations differ in the way in which they allocate their overhead expenses and individual accountants have different opinions about the way in which such items should be treated. It is to be expected that there will be considerable variations in figures from different sources unless care is taken to establish a standardised approach.

B.3 COST FRAMEWORK

Despite the reservations expressed above and the possible danger of mis-interpreting any specific figures, it is felt that a worked example will have some value in giving an appreciation of the factors involved.

To give a positive framework, the figures are related to a hypothetical research centre with a vigorous publication policy and employing a total of 500 staff, including the equivalent of 5 full-time people in various aspects of report

production (see Table 6). This is not presented as a typical number for such an establishment, but it is a level at which each individual would have a readily identifiable function for the purpose of costing. It is certainly not the lowest viable size; there are many smaller units efficiently producing documentation on an occasional basis, with staff who are primarily engaged on other reprographic work.

The items of cost will be considered in three categories, under which other overhead expenses may be collected:

Staff.
Equipment.
Materials.

It is assumed that the activities cover litho printing and microfilming and the associated preparation of camera-ready material. The costs of scientific manpower in authorship and vetting (which may constitute a considerable expense) are excluded from this exercise.

B.4 STAFF COSTS

In addition to the salaries paid, there are several items that add to the cost of employing staff. These can be assessed for convenience of calculation as percentages of the basic salary and include:

(a) Pension and insurance contributions.

(b) Accommodation-related overheads.

(c) Administrative support overheads.

By the combination of these items, an 'overhead factor' may be calculated; it is not unusual for these indirect expenses to equal the direct salary expenses and the total staff costs would then be expressed as 'salary plus 100%'. Still higher factors may be appropriate for high-cost accommodation and facilities.

In paragraph 7.3 a range of skills covering 11 people has been shown in relation to the work of a publication unit. In a small establishment, such a number would not be fully employed in this work and the more basic structure of 4 people plus occasional help is taken here as the basis for calculation (see Table 6).

The salaries for this group would be in the order of £20,000 at the UK Civil Service rates for mid-1979. If an 'overhead factor' of 100% was found to be appropriate, a figure of £40,000 would emerge as the annual cost of staff and associated overheads.

TABLE 6

Example of Staff Structure and Costs

Stage of Production	*Number of Staff*		*Total Salary**
Preparation	Typists	(2)	£11,000
	Tracer/Illustrator	(part time)	
	Photographer	(part time)	
Printing	Reprographic staff	(2)	£ 8,000
Microfilm	Microfilm operator	(part time)	£ 1,000

* Including an element for supervision

For some purposes, such as photocopying, it is convenient to express the staff costs per minute. In such cases, it is useful to assume that the working year contains 100,000 minutes:

(45 weeks at work x 5 days per week x 7½ hours per day x 60 minutes per hour)
= 101,250 minutes, or 100,000 minutes approximately)

An annual salary of £3000 can thus be reckoned as £0.03 per minute.

B.5 EQUIPMENT COSTS

B.5.1 Purchase Price

The facilities needed to produce scientific reports includes typing, photographic, litho printing and microfilming equipment. The purchase of such items is best left to specialists and it is not intended here to comment on the vast

range of equipment currently marketed. Nevertheless, it is possible in general terms to list the major items needed for a self-contained publication unit (see Table 7). It will be recognised that many of these items may also be useful for other purposes within the organisation – which would then fairly attract a share of the associated expenses, thereby leading to lower costs for the publication activity.

The 2:1 range of cost shown in Table 7 is not unrealistic; it serves to make the point that equipment specifications differ considerably. The necessary balance, between highly-productive (but expensive) equipment and more labour-intensive methods, requires careful study in the light of local circumstances. The lower total of £25,000 in Table 7 could certainly be reduced by adopting manual methods at some stages; on the other hand, the sum of £50,000 would be insufficient for a medium or large-scale unit.

There is no intention here to justify any detailed figures, the object of the exercise is simply to indicate the order of cost for a relatively modest publication unit. It is evident that for this range of litho and microfilming work, the capital investment will be measured in tens of thousands of pounds.

B.5.2 Installation

Table 7 does not include the many items of specialised furniture or darkroom and workroom equipment. Nor does it cover the expense of installing plumbing, waste disposal, heat extraction, dust extraction, ventilation, air conditioning and power supplies.

The running costs associated with these building services would normally be covered by setting them as part of the accommodation overhead, which in turn may be treated as part of the staff cost (see paragraph B.4).

TABLE 7

Major Items of Report Production Equipment
(approx. UK prices. mid-1979)

Preparation		
Electric typewriters, with interchangeable type heads (two machines)	£1400–£ 1800	
Small process camera for litho negatives and other copying work	£1500–£ 3500	
Film processor for litho negatives	£1700–£ 4500	
Photo-typesetter and processor (for captions)	£1200–£ 2500	
Photographic enlarger (5" x 4")	£ 400–£ 700	
Bench-top processor for bromide prints	£ 600–£ 1000	
		£ 7000–£14000
Printing		
Exposure unit for metal plates	£ 300–£ 400	
Camera-platemaker for plastic or paper plates	£4000–£ 7000	
Offset litho printing press (A4 size)	£2500–£ 5000	
Plate converter	£ 200–£ 300	
Collating machine	£ 500–£ 2400	
Wire stitcher	£ 500–£ 900	
Power guillotine	£1000–£ 2000	
Photocopier	£1000–£ 2000	
		£10000–£20000
Microfilming		
Microfiche camera	£5000–£10000	
Microfilm processor	£1200–£ 2500	
Densitometer	£ 200–£ 500	
Microfiche duplicator	£ 800–£ 1800	
Microfilm reader-printer	£ 800–£ 1200	
		£ 8000–£16000
	Total	£25000–£50000

B.5.3 Equipment Expenses

Quite apart from the initial funding, the ownership of equipment brings a number of expenses, which may be summarised under three headings:

(a) Interest on capital

Putting aside the accounting arguments over whether interest on capital should, or should not, be included in cost accounts, the purchase of equipment represents a loss of opportunity to invest the money elsewhere. The same argument applies to funds spent on buildings and the use of cash (working capital), but these are excluded from the present example. This 'opportunity cost' is usually represented as a cost in succeeding years, by calculating the interest that would have been gained from investing the money elsewhere. Thus, if the £25,000 which is spent on equipment, could have earned interest of £2500 p.a., the latter sum would be set as a charge on the publication activity.

(b) Depreciation

For accounting purposes it is necessary to allow for the depreciation of the equipment. In times of inflation, it is considered good accounting practice to base the depreciation on the replacement cost of the asset. Using the simplest 'straight line' method of depreciation and assuming an average equipment life of 7 years, the annual depreciation could be assessed as in Table 8. For the purpose of later calculation, the Table allocates the depreciation costs to the three main activities:

Preparation (typing, illustration, photography).
Printing (plate-making, printing, finishing).
Microfilming (camera work, duplicating)

TABLE 8

Annual Depreciation – A Worked Example

	Replacement Purchase Price	*Estimated Trade-in Value (after 7 years)*	*Life-time Depreciation*	*Annual Depreciation (assuming 7 year life)*
Preparation	£ 7000	£1000	£ 6000	£ 860
Printing	£10000	£2000	£ 8000	£1140
Microfilming	£ 8000	£1000	£ 7000	£1000
	£25000	£4000	£21000	£3000 p.a.

(c) Maintenance costs

The regular servicing of equipment is one of the keys to effective operation. The working schedule must include an allowance for maintenance and cleaning, which naturally reduces the number of productive hours in a week and is reflected in the job costs.

With highly productive equipment, upon which a large staff may depend for their effective employment, unplanned breakdowns can be disruptive and expensive. A policy of preventative maintenance, using a service contract, gives a more regular and predictable expense and the timing can be chosen to suit local needs. A contract by no means excludes the possibility of break-down, but it is generally felt to be a necessary insurance. Indeed, when buying key items of equipment, the existence of a rapid and reliable servicing organisation is a major (if imponderable) factor in selecting the supplier.

The cost of a service contract depends upon many factors, but for the present exercise a figure of 10% of the purchase price is taken as the basis for the annual charge. For the equipment listed in Table 7 a provision of £2500–£5000 could be appropriate for servicing, plus the cost of any replacement parts. Such agreements would be the subject of an annual review by the supplier.

The need to keep records of expenditure for each machine is noted in paragraph 6.1.4.

B.5.4 Equipment Rental

Most government organisations prefer to purchase their equipment outright, but there are a number of alternatives. Hire purchase and contract leasing are offered by some suppliers and rental schemes are commonly operated in the office machinery field.

Investment decisions of this type are largely made on financial grounds, bearing in mind the complexities of cash flow and taxation. The only technical factors bearing on the matter are:

(a) The possibility of an impending change in technology that may make long term investment unwise.

(b) The feeling that a rental agreeemnt puts the user in a stronger position to demand rapid service.

Rental charges vary considerably, but it is not unusual for the monthly charge to be about 3% of the full purchase price; a service contract might be additional to this figure.

B.6 MATERIAL COSTS

The major consumable item associated with report production is litho paper. Commercial prices for a good medium weight (100 gsm) litho paper range from about £4 to £3 per 1000 A4 sheets; the lower figure relating to deliveries of a tonne or more (a tonne of 100 gsm paper gives 10,000 m^2, or 160,000 A4 sheets). As will be shown below, even a moderate printing operation will consume a few tonnes of paper per year. It is more economical to buy this material in bulk but the saving must be set against the cost of providing suitable storage: paper that is not kept in good condition will give trouble during production.

For a given output, the expenditure on materials and consumables can readily be estimated. For example, with an output of 100 reports a year, each of 25 sheets (50 pages of content) and a run of 200 copies of each report, the paper usage will be 500,000 A4 sheets p.a., with an approximate cost of £3 x 500 = £1500. The other consumables will include photographic materials, chemicals and litho inks, but the most significant item will be the litho plates. The work load suggested above calls for 100 jobs x 50 plates = 5000 plates p.a. which, with paper plates at a cost of 10p, indicates an annual cost of £500.

In the present example the total expenditure on litho printing materials, including wastage and unavoidable over-runs will be in the order of £2500.

The materials needed for internal microfilm publication would be considerably less than those for the paper version. The silver microfiche master (£0.10 each) plus 200 diazo duplicates (£0.03 each) would cost £6.10 for each report, giving an annual material cost of £610 for 100 reports.

B.7 SUMMARY OF PRODUCTION COSTS

The cost elements calculated above for this hypothetical report activity may be summarised as in Table 9. It is assumed that 100 reports are written each year, with a requirement for 200 paper copies and 200 microfiche copies.

TABLE 9

Summary of Internal Production Costs – A Worked Example

	Preparation	*Litho Printing*	*Microfilming*	*TOTAL*
Capital costs (£25,000 total investment)	(£7000)	(£10000)	(£8000)	
Interest (10% p.a.)	£ 700	£ 1000	£ 800	
Depreciation (7 years)	£ 860	£ 1140	£1000	
Maintenance (10% of cost p.a.)	£ 700	£ 1000	£ 800	
	£2260	£ 3140	£2600	£ 8000
Materials (100 reports x 200 copies x 50 pages)	£ 200	£ 2300	£ 610	£ 3110
Staff costs and supervision				
Salaries	£11000	£ 8000	£1000	£20000
Staff overheads (100% rate)	£11000	£ 8000	£1000	£20000
	£24460	£21440	£5210	£51110

The costs for each stage of the activity can be expressed as follows:

	Total cost		
Preparation of 100 reports p.a.	£24460	= £244.60 per job	= £1.22 per copy
Printing 20000 report copies p.a. (100 jobs x 200 copies)	£21440	= £214.40 per job	= £1.07 per copy
Total litho production cost	£45900	= £459.00 per job	= £2.29 per copy
Production of microfilm (100 jobs x 200 duplicates)	£ 5210	= £ 52.10 per job	= £0.26 per copy) (excluding preparation cost)

B.8 BUREAU COSTS

In most large towns there is at least one commercial printer or 'print shop' that is able to produce litho-printed reports to the standard required for publication. In many cases, the security regulations preclude the use of external

printers, but it is instructive to have a knowledge of local commercial prices. The scales of charges can vary widely, but typical bureau costs for the work-load set out in Table 9 would be as follows:

Printing (including plate-making)	
200 copies from one master – £5	
per 50-page report (25 sheets) – £5 x 50	= £250
Finishing (including collating, stitching, trimming)	= £ 20
Total for job	= £270

The total cost for a year's output of 100 litho-printed reports would thus be £27,000.

Microfilm bureaux also exist in most cities, although not all can produce microfiche by the preferred step-and-repeat method. Typical charges would be in the order of £6 for a microfiche master, plus £0.12 for each diazo duplicate. A run of 200 copies would thus cost £30 including the original filming and a sum of £3,000 would cover the annual output of 100 reports assumed in this example.

There is usually a minimum charge for any order; this may be £10 or £20, depending on the bureau price structure, so the notional savings of microfilm production may be somewhat reduced for an irregular, small-scale operation. The expense of administration and postage must also be considered when decisions are made about the use of a bureau.

B.9 COMPARISON OF INTERNAL AND BUREAU COSTS

B.9.1 Litho Printing

In the example given, the preparation cost (typing and illustration) for 100 reports is shown to be £24460. It will not usually be practicable to send this work to an outside agency, because of the need for close liaison with the author. However, in the absence of any security restrictions, it may be possible to use an outside bureau for the printing and finishing stages, the relative internal and external costs are then of interest. Using the figures from B.7 and B.8, the following hypothetical comparison emerges:

	Internal production	Using a bureau for printing
Preparation cost	£24460	£24460
Litho production	£21440	£27000
Total p.a.	£45900	£51460

For the chosen conditions and cost assumptions, it appears that the internal printing operation would be the cheaper option – although, if more expensive equipment had been selected, this might not be the case. Furthermore, without going too far into the realms of conjecture, it is quite probable that some of the staff and equipment would be under-utilised with the stated work-load. If additional work could be undertaken from elsewhere within the parent organisation, many of the cost elements could be shared over a larger work-load; the consequent reduction in the amount attributable to the scientific documentation would increase the price advantage of internal production.

B.9.2 Microfilming

For simplicity, in this example the preparation costs are regarded as part of the litho printing operation. For microfilming, there is therefore a simple comparison between the internal and bureau costs calculated in paragraphs B.7 and B.8:

Internal cost £5210 Bureau cost £3000

A number of factors might outweigh this cost advantage of the bureau, but at first sight there is a clear case for the use of the external contractor or some central agency. The internal operation clearly suffers from the burden of relatively expense, under-utilised equipment: for example a camera costing £5000 is only used to make 2 masters a week.

B.10 SUMMARY

The preceding calculations have reached certain conclusions in the specific circumstances of the example, but this cannot be taken as a general statement about the viability of internal production. The exercise has been carried through simply to show non-specialists a possible structure for such calculations and to suggest some of the simplifying assumptions that may be appropriate. In practice, professional accountants will advise on the most suitable method of treatment to meet the needs of the organisation.

Despite the general need for economy, it is not suggested that cost is always the over-riding factor. As pointed out in paragraph 2.1, there are several other criteria that determine the effectiveness of a publication programme: aspects

such as quality, reliability, security and speed of access. All these factors bring cost penalities to some degree and it is desirable for staff at every level to be aware in broad terms of the expense involved. For example:

(a) Authors can often make useful economies by suitable choice of presentation.

(b) Operating staff can give practical attention to the areas in which cost reduction is shown to be the most effective.

(c) The publication management is given a firmer basis for planning current work and future investment.

Provided that the cost information is available in a meaningful form, the R & D directorate will be able to assess the value of the publication work in relation to their central aim. If the major objectives are to conduct research and to communicate the results to the scientific and technical community, the cost of producing the documentation is an essential part of the programme and must be given realistic budgetary provision.

BIBLIOGRAPHY

In addition to the specific references given throughout this Section, there are a number of books that can be recommended for further reading.

1. REPROGRAPHY

'A guide to reprographic processes for the small user' by T.Hampshire. Agardograph 199 (1975).
'Reprographic management handbook' by F.C.Crix. Business Books, London. 345 pages 2nd edn. (1979).

2. MICROFILM

(a) Microfilm is fast-growing field of activity, but a sound introduction to current systems is offered by:
'Microfilm system: design and implementation' Microfilm Association of Great Britain (MAGB), 8 High Street, Guildford, Surrey, UK. 56 pages (1977).
'Micrographic systems' by D.M.Costigan. National Micrographics Association (NMA), 8728 Colesville Road, Silver Spring, Maryland 20910, USA, 250 pages (1975).

For librarians, an excellent further reference is offered by:
'Microform librarianship' by S.J.Teague. Butterworth, London, UK. 125 pages 2nd edn (1979).

(b) Three useful equipment guides are published by G.G.Baker & Associates of 54 Quarry Street, Guildford, Surrey (who are also UK agents for NMA, MAGB and BSI micrographic publications). These books have become the continuing source of reference for the microfilm equipment available in the UK – and much of the information is relevant to microfilm users elsewhere.
'A guide to microfilm production equipment' 2nd edn. (1977).
'A guide to microfilm readers and reader-printers' 4th edn. (1979).
'A guide to Computer Output Microfilm' 5th edn. (1979).

For users in the United States, a similar role is taken by the NMA publication:
'Guide to micrographic equipment' 2 vols. 7th edn. (1979).

(c) For the individual research worker and user of microfilm, a useful introduction is available in an earlier AGARD publication:
'The use of microfiches for scientific and technical reports – considerations for the small user' B.J.S.Williams and R.N.Broadhurst. 21 pages AGARD-AG-198 (1974).

(d) For detailed descriptions and ratings of microfilm equipment, The NRCd Evaluation Reports have a reputation for a thoroughly practical approach. Quite apart from any interest in the specific items of equipment, the description of the test methodology and the critical discussion of the results can serve as useful educational material in its own right. Details of the subscription service are available from:
The National Reprographic Centre for Documentation, Hatfield Polytechnic, Endymion Road, Hatfield, Hertfordshire, UK.

3. JOURNALS

The fields of reprography and microfilm are subject to continuing technological progress and market change. The following are given as examples of journals available in the UK that will help interested parties to keep abreast of current developments in equipment and methods.

'Reprographics Quarterly' published by NRCd,
'Microdoc' published quarterly by MAGB,
'Microinfo' published monthly by Microinfo Ltd., P.O. Box 3, Alton, Hants.,
'Reproduction' published monthly by B.E.D. Business Journals, Restmor Way, Wallington, Surrey.

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14. Abstract

The third of four separately published volumes describing the basic documentation practices involved in the initial setting up and operation of an Information-Library organisation to provide defence-aerospace information services. The focus is on a practical, rather than theoretical, approach for both the senior person setting up a new system as well as junior staff, who may be using the manual as a training aid.

This volume consists of three main sections. The first section describes aspects of information retrieval and includes the principles of post co-ordinate indexing and examples of feature and edge punched card systems; the use of computers to produce various types of indexes and the role of 'dial up' on-line systems. In the second section, information dissemination practices are outlined and a survey of procedures used by a number of international technical information centres is given. Section three describes the preparation and reproduction of R & D publications in both paper and microfilm media. The factors involved in setting up production facilities are discussed.

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